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Powdered Coal for Malleable--I

Experimental Results Indicate Advantages of the Use of Powdered Fuel Over Hand Firing—Coal of Uniform Quality Must Be Ground To Exact Fineness—Little Danger from Fire in Bins

BY T. W. ATTERBURY

CERTAIN distinct advantages are obtained in economy and ease of operation when substituting powdered coal for hand-fired coal in melting and annealing malleable iron. Some of these may be cited as follows:

Cleanliness, with an absence of smoke in the foundry, and little or none in the surrounding atmosphere;
Saving in coal consumption, or in time, or both;
Saving in labor;
Less scrap when pouring off;
A more uniform product is obtained;
Heat can be tapped on time;
Increased capacity of furnace;
Less repairs to brick lining;
Better working conditions.

These articles are based on practice at the plant of the T. H. Symington Co., Rochester, N. Y.

In support of these claims the following notes are given:

Any person who has seen hand firing on an air furnace, as this type of reverberatory furnace is generally called, must have remarked the hard, laborious work required. He also must have noticed the wasteful method of filling the foundry and the surrounding atmosphere with smoke during the greater part of the heat, owing to the firing door being open a large proportion of the time. With powdered-coal firing smoke is not emitted into the foundry and no manual labor is required in delivering the fuel into the furnace. In some instances state laws have been instrumental in improving conditions around an air furnace by prohibiting the smoke and forcing the foundry to adopt some better method of firing than by hand.

In our hand-firing practice the average coal ratio obtained was 2.45 tons of iron melted to 1 ton of coal, and the melting rate was 2.75 tons per hour. With powdered coal, the average coal ratios obtained are 3.5 to 1 for the morning and 4.5 to 1 for the afternoon heat, charged into a hot furnace; an average of 4 to 1 for two heats of 26 tons per furnace per day. Occasionally rather better results are obtained, the average going up to 4.5 to 1 for the day. The melting averaged 3.8 tons per hour for two heats, with occasionally 4 tons per hour or perhaps a little better.

FIG. 1—GENERAL ARRANGEMENT OF A 25-TON FURNACE E QUIPPED WITH POWDERED COAL—THE POWDERED COAL STORAGE BIN IS LOCATED IN A PIT WITH THE TOP OF TH E BIN LOWERED TO ALLOW THE CRANE TO PASS OVER IT

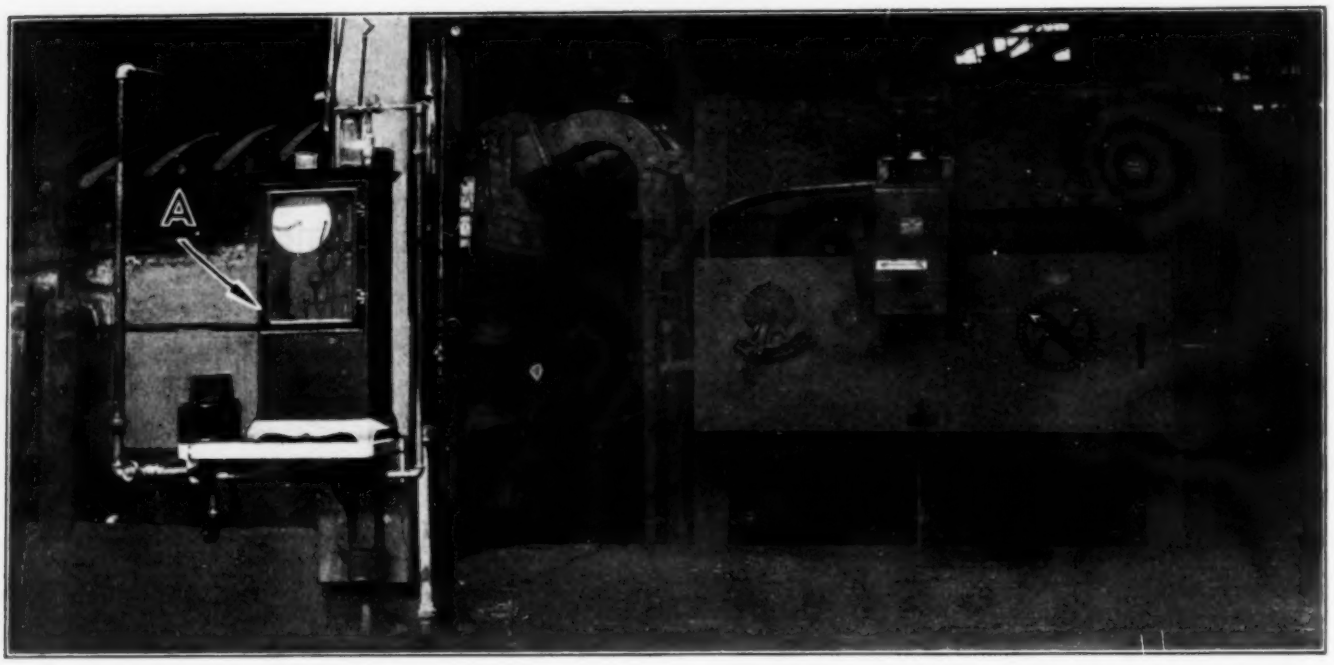


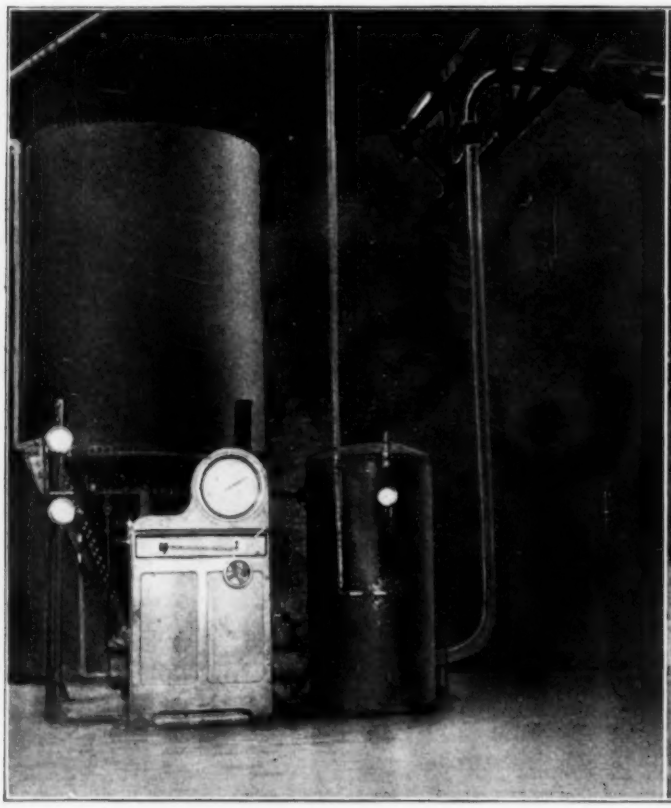
FIG. 2—CLOSER VIEW OF THE BIN AND BURNER SHOWN IN FIG. 1—NOTE THE CARBON-DIOXIDE RECORDER SHOWN AT A

The labor is easily cut in two, and with a number of furnaces operating on powdered coal it is possible to do better than this. With the laborious hand firing eliminated a better and more intelligent class of labor can be induced to take up furnace operation.

Less hard iron scrap is produced, owing to the iron being uniformly hot and of sufficiently high temperature in pouring off; also from the fact that less difficulty is experienced in getting iron of the required uniformity as regards chemical and physical characteristics.

Analyses show a more uniform product is obtained when using powdered coal, owing to the melting being carried on with perfect regularity from day to day and eliminating to a large extent the personal equation. When it is found that a certain charge and method of firing give a good quality of iron in chemical analysis and physical characteristics, it is possible to duplicate this with a reasonable degree of certainty, thus making for uniformity of product.

It is important that the heats come on time; with a furnace running two



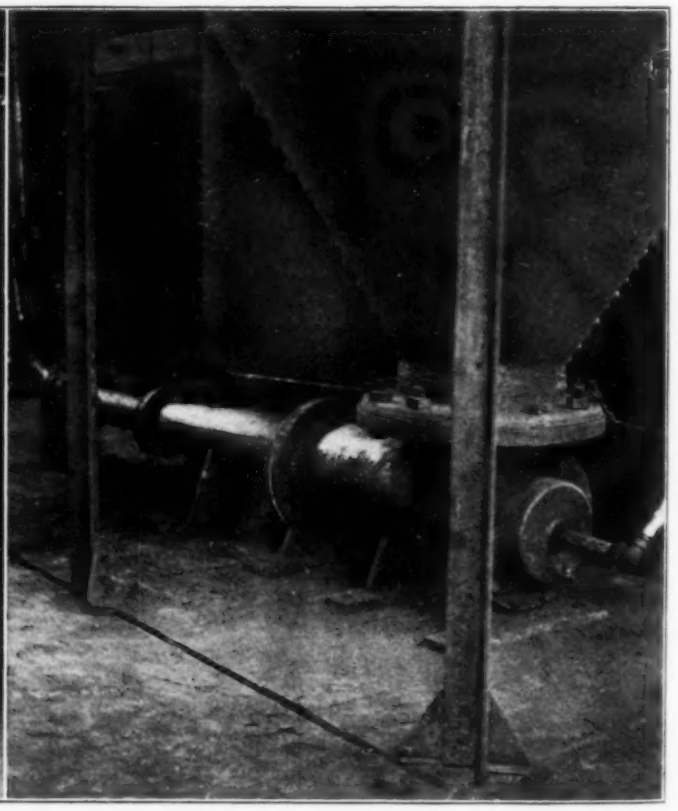


FIG. 3—VIEW OF THE WEIGHING TANK, SCALE, AND COMPRESSED-AIR RECEIVER FIG. 4—BOTTOM OF THE WEIGHING TANK SHOWING THE COAL DISTRIBUTOR WHICH FEEDS COAL INTO A VERTICAL TANK AT THE LEFT

heats per day it is desirable to have the first heat ready to tap soon after the molders start work. It is also important to have the second heat poured so that the molders can get away without working overtime, which would add to the cost of castings. With powdered-coal firing, clinker and grate troubles are eliminated and the heat is not delayed by exhaustion of the fireman during the hot summer weather. The heat comes along with almost mathematical regularity, so that the chemical composition of the iron when poured is as it has been calculated.

In changing the furnace from hand fired to powdered coal, the firebox is removed and the length of the furnace is increased by this amount, the burners being inserted through the end wall. The cross section of the furnace being a maximum at this point, the capacity of the furnace is increased probably 25 per cent. With four or five furnaces changed over, an increase in capacity of the plant is gained equivalent to an additional furnace.

Comparison of cost of brick used in the bungs and side walls shows a saving in favor of powdered coal. It is conservative to estimate a saving of 10 to 20 per cent on bung brick, and 25 to 40 per cent on side walls.

It is important to get suitable burning equipment and avoid experimenting with and perfecting apparatus at the expense of lost heats and poor quality of iron. The writer's early experience was with experimental equipment, being in a pioneer period when suitable burners and feeders had not been put on the market. Many troubles were encountered principally in coal transportation, coal feeders and burners.

Coal transportation troubles were due to the inability to transport large quantities a considerable distance in a short time. This problem has been solved satisfactorily by the use of compressed air or a high-speed screw pump. Coal feeder troubles were due to lack of uniformity of feed, the coal coming in varying quantities and resulting in a fluctuating temperature and a varying atmosphere in the furnace adding to the furnaceman's troubles considerably. By improving the mechanical design and construction, feeder troubles have been largely eliminated.

Burner troubles were due principally to improper mixing of the coal and air, and to the coal feeders not functioning well. The size and capacity of burners are now better understood and modern burners do not cause any operating trouble. While excellent coal ratios and a high melting rate were obtained in the early use of the experimental furnace, it was not possible to maintain these records owing to the experimental equipment not standing up under continuous service. However, the results obtained were such as to warrant purchasing more suitable equipment, which has been in operation two years with gratifying results.

Among other results of the experiments it was found that top blast was not necessary and that preheated air was not practical on an air furnace; also, a combustion chamber was found to be unnecessary and the charge now is put in the furnace to within 4 feet of the burners. A stack damper is required. This has not been put in the throat, but consists of an opening in the stack base which can be regulated to vary the intensity of the draft.

Slight Pressure in Furnace

The proper pressure in the furnace under the gradually increasing volume of furnace gases is important and the furnaceman should regulate the draft to give a pressure on the furnace just enough to cause a small flame to issue to the atmosphere through an opening in the furnace side wall. Burning coarse coal was experimented with and abandoned. It was found that coal ground to 76 per cent through a 200 mesh screen was not burned thoroughly, but was deposited on and in the charge, affecting the composition of the iron and delaying the heat. It was found necessary to grind to about 85 per cent through a 200 mesh screen, with 1 per cent moisture, or less.

A fair quality of coal is necessary to keep up the operating schedule. A coal pile having several grades of coal approximately the same analysis will usually cause trouble to the furnaceman, owing to the different burning characteristics encountered. A bituminous coal of a size to pass a 1-inch mesh screen and of the following analysis is considered satisfactory for malleable iron melting:

Volatile matter	33 to 35 per cent
Fixed carbon	54 to 58 per cent
Ash (high melting)	6 to 12 per cent
Sulphur	1 to 1½ per cent
Moisture	1 after drying
Calorific value	13,600 to 14,000 B.t.u.

Drying and grinding should be carefully watched and uniform results should be striven for, as coal ground to 75 per cent mesh one day and 85 per cent the following day will affect the furnace operation and result in delayed heats and iron of varying quality. The chemical analysis and characteristics of the charge are affected by varying fineness of coal, owing to incomplete combustion and varying furnace temperature, or as a furnaceman would probably describe it, as lack of control. Varying moisture caused by improper drying will result in mechanical difficulties in transporting the coal, and in feeding the coal from the bin to the burners. This irregular feed will give a varying furnace temperature and a poor melting condition.

Ample coal conveying capacity from the preparation plant to the furnace is necessary to avoid delay, particularly where a large number of furnaces

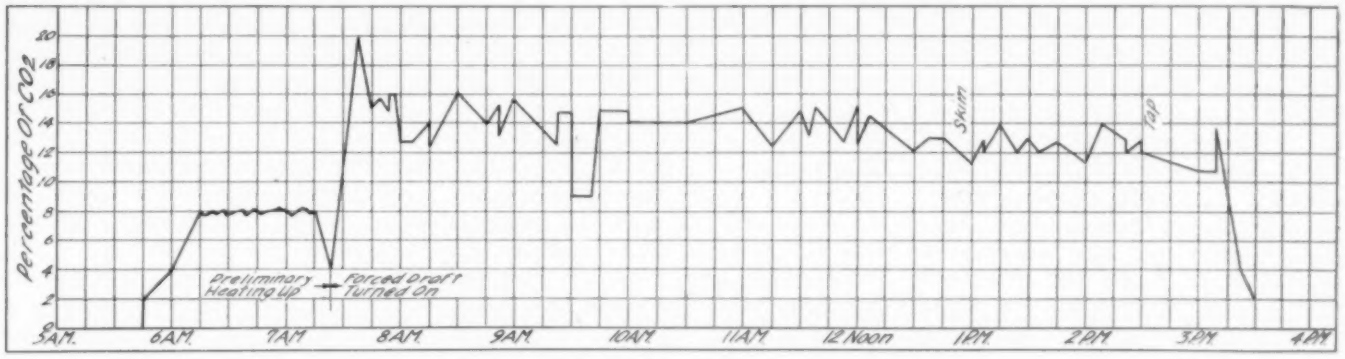


FIG. 5—CHART OF A CARBON-DIOXIDE RECORDER SHOWING THE PERCENTAGE OF CARBON DIOXIDE IN THE COMBUSTION GASES THROUGHOUT THE HEAT OF A HAND-FIRED FURNACE

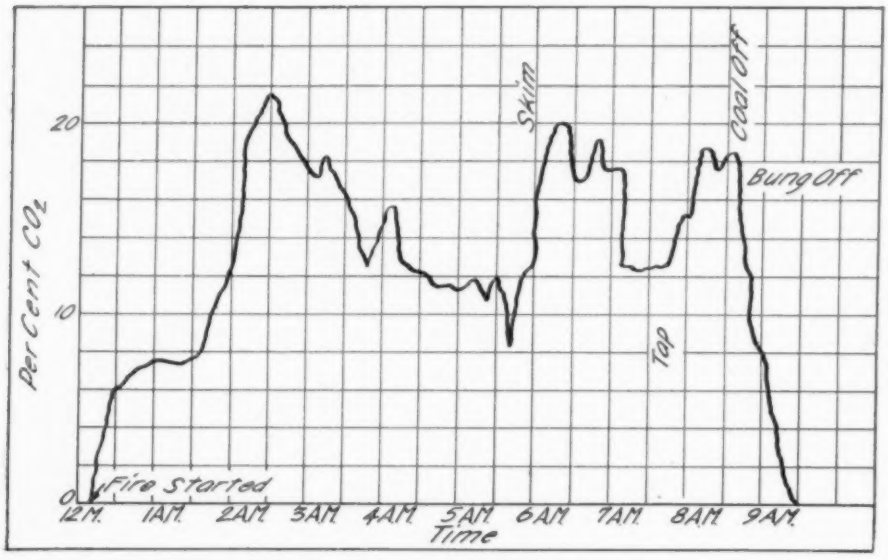


FIG. 6—CARBON-DIOXIDE RECORD OF A MORNING HEAT IN A FURNACE FIRED WITH POWDERED COAL

are in operation. The latest conveying systems are equipped with automatic bin signals to show when the bin is full or empty, and the conveying is under automatic electric and air control. An absolutely safe method of conveying is through pipes in a sealed system, the coal being fed to the system as a solid and mixed with just sufficient air to reduce the friction in the pipes and to give the moving coal the properties of a dense fluid. Three methods of conveying are in general use; the screw conveyor for short distances, and the pneumatic method and the high-speed screw pump using compressed air of 20 to 40 pounds pressure, for long distances up to several thousand feet. The feeder bin at the furnace should be of ample capacity. This is usually governed by local conditions of space available.

The most important features of bin design and construction are slope of the bottom, tightness of the joints to prevent leakage, and a vent for the air used in conveying the coal. Much has been written about proximity to hot furnaces, but with ordinary care, coal in the bin will not take fire. In case of a fire being discovered in a bin, the best way to handle it is to keep on feeding it into the furnace and burn it up as soon as possible. A bin improperly constructed at the bottom will result in irregular feeding and varying furnace temperature. If the air vent is not functioning, the specific gravity of the powdered coal is variable, causing irregular feed to the burners.

On a melting furnace the coal feeder is of first importance. It is not exaggerating to say that the best feeder will give the best melting results in time, fuel economy, and quality of iron produced. The reason for this is that a maximum and constant temperature is maintained, the furnace being under positive control of the operator. Therefore, the resulting iron is of the desired chemical and physical properties, being produced day after day, and avoiding experimental work in figuring the furnace charge. The furnace feeder is usually a screw of horizontal or vertical design, running at a variable speed and delivering a constant weight of coal each revolution.

It is desirable to have the feeders of ample capacity so that in case one feeder of the two or three generally installed should fail, the remaining feeders will bring the heat to a successful finish. When the feeders deliver the powdered coal from the bin, it is usually picked up and conveyed to the burners by the air which is required for complete combustion.

For best results, the coal and air should not be delivered to the burners in a stratified condition, or as a core of coal surrounded by air, but the mixture should be as perfect as possible so that the entering mass is in the form of a dust cloud of uniform density. This uniformity is generally obtained mechanically by fan-shaped mixers or carburetors located in the path of the moving mass of coal and air. When the mixing is perfect, complete combustion takes place at the burner mouth if desired, and in melting furnaces practically complete combustion is obtained within three or four feet of the burner mouth and before reaching the charge.

Should the power be cut off for a period of 1 to 2 hours with the charge down and in a fluid or semifluid state the furnace gradually can be brought up to heat again, after the power has been turned on, without much difficulty if, while the fire is off, the furnace is sealed up at the stack and other openings to prevent radiation losses as far as possible.

Fig. 1 shows a general arrangement of a 25-ton furnace equipment with powdered coal. The coal bin is located in a pit with the top of the bin lowered to permit the charging buckets to pass over it. The coal enters the bin through the 4-inch pipe on the right. Fig. 2 is a detailed view of the bin and burners. The coal and air are blown up the vertical pipes and enter the end wall of the furnace at an angle of about 30 degrees to the horizontal. Figs. 3 and 4 are part of the coal conveying equipment. Fig. 3 showing the weight tank, scale and

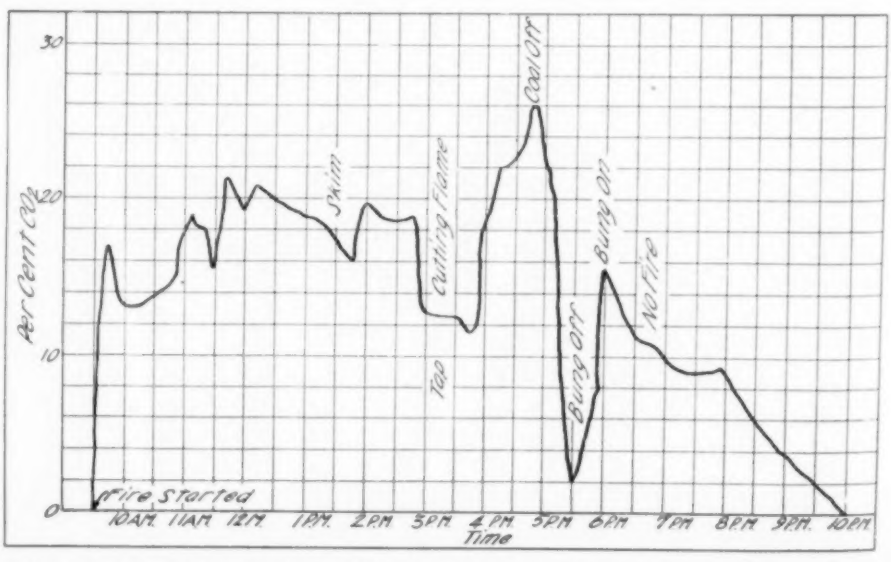


FIG. 7—AFTERNOON HEAT FROM THE SAME FURNACE RECORDED IN FIG. 6

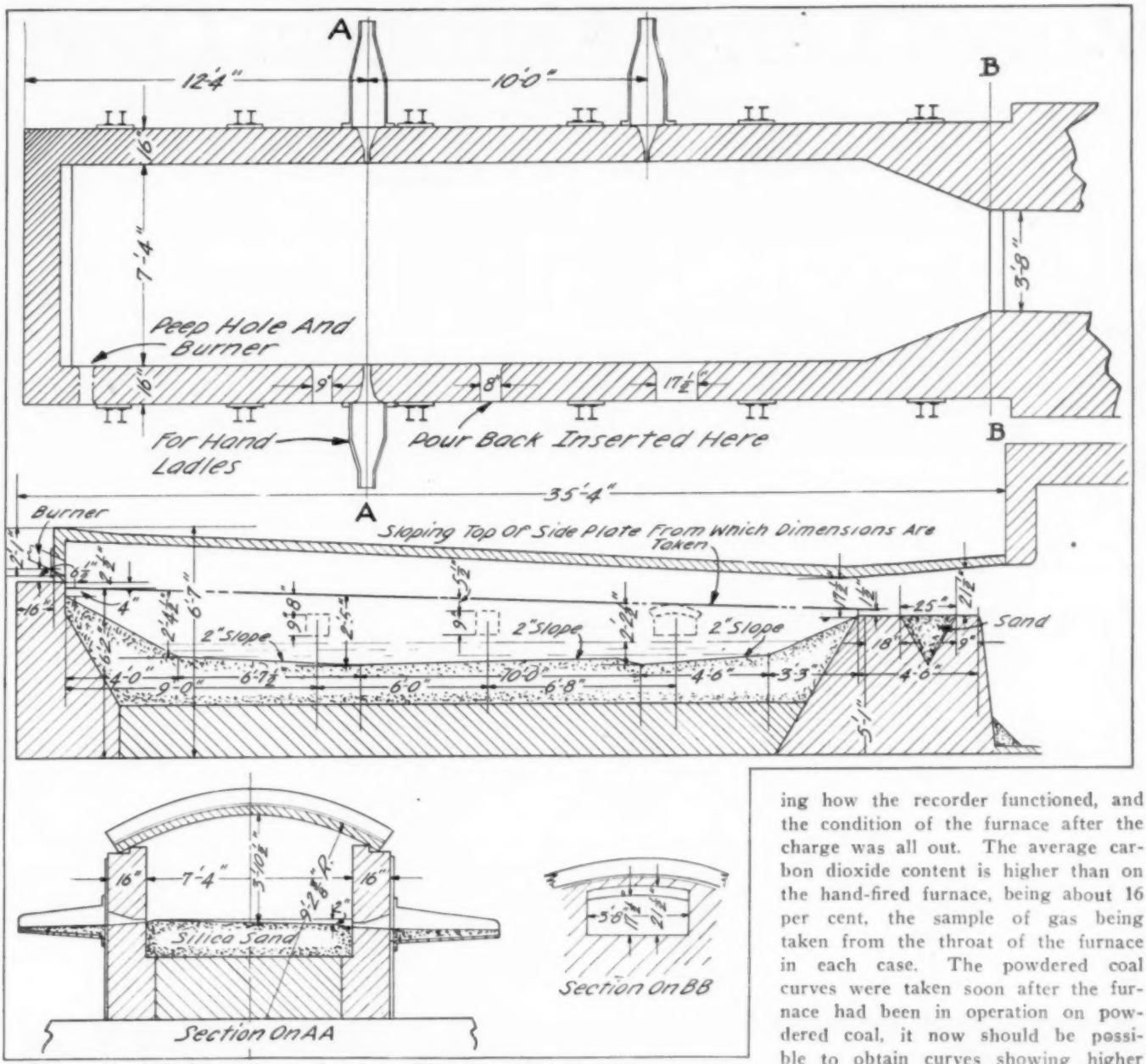


FIG. 8—DETAILED PLAN AND ELEVATION OF A 25-TON MELTING FURNACE EQUIPPED FOR BURNING POWDERED COAL

compressed air receiver, and Fig. 4 giving a larger view of the bottom of the weight tank and the coal distributor, which feeds the coal into the 4-inch pipe rising vertically on the left. This leads to the furnace bins.

In checking up the efficiency of an individual furnace, the factor which gives most trouble, and which is most susceptible of variation is coal feed.

As previously explained, with irregular coal feed, it is not possible to get maximum temperature of combustion, nor can a constant temperature be maintained. By an analysis of the furnace gases using an automatic carbon dioxide recorder, the efficiency of combustion can be checked and the trouble, if any, located.

A low carbon dioxide content is caused by the air and coal not being supplied in the proper proportions. This can be readily corrected by the furnaceman. If the curve shown by the carbon dioxide recorder is wavy, the trouble is caused by irregular feed.

A recorder attached to the furnace is indicated at *A*, Figs. 1 and 2. The curves Figs. 5, 6 and 7 show carbon dioxide charts from 3 heats. The chart shown in Fig. 5 was taken on a hand-fired furnace with an 18-ton charge, single heat, indicates the total time of the heat and the percentages of CO_2 obtained during the heat, the average being around 14 per cent.

Figs. 6 and 7 are from a powdered-coal furnace with 26-ton charges, Fig. 6 being the morning and Fig. 7 the afternoon heat. The time of starting and tapping is given, also a period after tapping the afternoon heat, showing how the recorder functioned, and the condition of the furnace after the charge was all out. The average carbon dioxide content is higher than on the hand-fired furnace, being about 16 per cent, the sample of gas being taken from the throat of the furnace in each case. The powdered coal curves were taken soon after the furnace had been in operation on powdered coal, it now should be possible to obtain curves showing higher CO_2 percentages than indicated here,

A good general outline of a 25-ton furnace is shown by Fig. 8. The reverberatory roof design shown was found to be better than any other, the distance from the hearth to the inside of the bung brick being 4 feet at the front and gradually tapering to 3 feet near the throat of the furnace. Experiments were made with different outlines of roof construction, some high, some low, also with straight roof and reverberatory arch.

In changing from hand firing to powdered coal little change in the furnace was required. The grate bars were removed and the front bridge wall was moved to the end wall, resulting in an increased length of furnace between bridge walls, and thus an increase of about 25 per cent in capacity was obtained. The powdered-coal burners enter the front wall.

Makes Large Aluminum Cowl

In Addition To Developing a Method for Forming the Mold Altogether in Green Sand, Provision Had To Be Made for Meeting Irregular Shrinkage and Contraction Strains

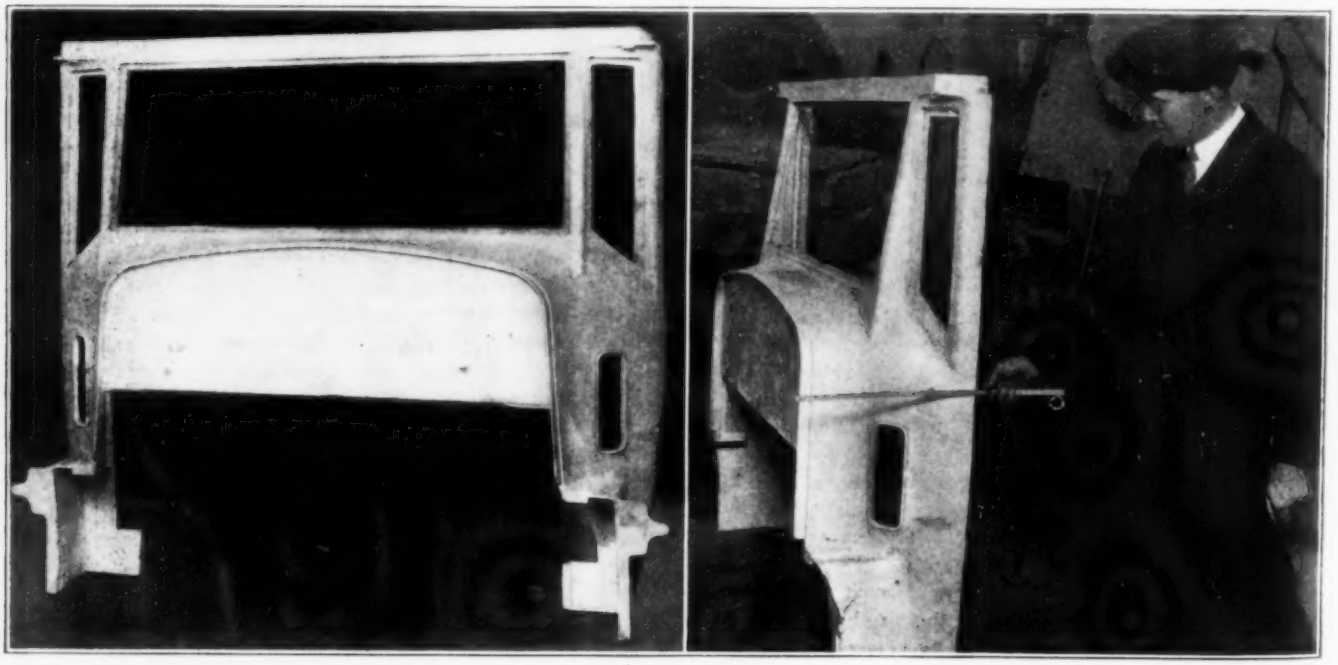
BY DON PARTRIDGE

ONE of the outstanding features in the new safety bus designed by the Fageol Motor Co., Oakland, Cal., is the extensive use of aluminum castings introduced with a view to reducing the total weight. These include the brake shoes, window frames, floor boards and cowl. This latter casting combining both cowl and wind shield with provision for door hinges, brackets for fenders, etc., measures 59 inches high, 64 inches wide and 16 inches deep with an average metal thickness of ¼ inch and a total weight of 118 pounds. The successful production of these large and intricate castings entails several interesting problems in foundry practice which have been solved in the foundry of McKinney & Spies, successors to the Van Niel Foundry, Alameda, Cal.

The mold is made on the floor in a wooden flask cut away at both ends to follow the general contour of the pattern and thus facilitate making the parting. The wooden pattern is mounted on a suitable follow board as shown in Fig. 5. The various loose pieces shown at the bottom of the main pattern are attached each time temporarily. The width of the casting must be held within close limits and therefore the pattern is molded face up to keep it firmly against the follow board and thereby prevent it from springing. The cope is rammed first and rolled over upon a sand bed. The follow board is removed, the loose pattern pieces adjusted, arbors set, etc., then the drag is rammed after which the entire mold is rolled back and the cope lifted off, the pattern is drawn and the mold finished in the usual manner. Two semicircular blocks, shown at *A* Fig. 4 are attached to the cope to facilitate rolling it over. Two men make one casting a day.

The wood pattern is made up of the main shell and 26 loose pieces. All the loose pieces with the exception of two are in the drag and are designed to form deep drawbacks for the various brackets and pads for supporting the cowl on the chassis, supports for the foot boards, brackets for the fenders, brackets for carrying the instrument board, pads for door hinges, etc. Many of these drawbacks are required due to the fact that the face of the casting must present a smooth, even surface and the use of dry sand cores would leave unsightly junction marks. The various drawbacks and pockets are made on special arbors and rammed up at the same time as the remainder of the mold. Two pockets extending from the joint to the bottom board and also well in under the dash board, are provided as shown at *B* in Fig. 4 to prevent the casting from cracking during contraction. Each pocket is approximately 3 inches wide and between the two, ample room is allowed for the sand to crush. Chills are provided at the pads and other points to prevent shrinkage cracks. The molds are not blacked but are skin dried with an oil torch and the metal is poured as soon as possible after the mold is dried.

Distribution of the gates to successfully run the casting and at the same time not cause warping or cracking was one of the interesting problems to be solved on this job. It is apparent that the metal must be poured hot and fast to fill the lower part of the cowl averaging ¼ inch in thickness and presenting a surface of approximately 15 square feet. The upper portion, forming the windshield with an average thickness of 5/16 inch and consisting principally of deep ribs showed a decided tendency to warp and pull away from the main body of the casting if poured too hot. In practice the casting is poured with three ladles. Two sprues are placed below the dash of the cowl section and two sprues are placed on the windshield side of the casting. The two latter sprues



FIGS. 1 AND 2—FRONT AND SIDE VIEWS OF ALUMINUM COWL AND WINDSHIELD CASTING FOR MOTOR BUS, 59 X 64 X 16 INCHES MADE ENTIRELY IN SKIN DRIED MOLD

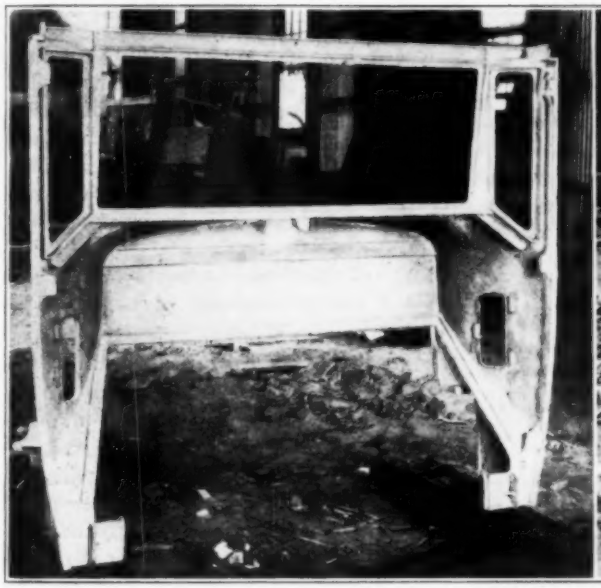


FIG. 3—INTERIOR VIEW OF CASTING FIG. 4—THE WOODEN FLASK IS CUT TO CONFORM TO THE SHAPE OF THE CASTING—TEMPORARY PIECES OF PLANK ARE PLACED IN THE ENDS OF THE COPE WHILE IT IS BEING ROLLED OVER

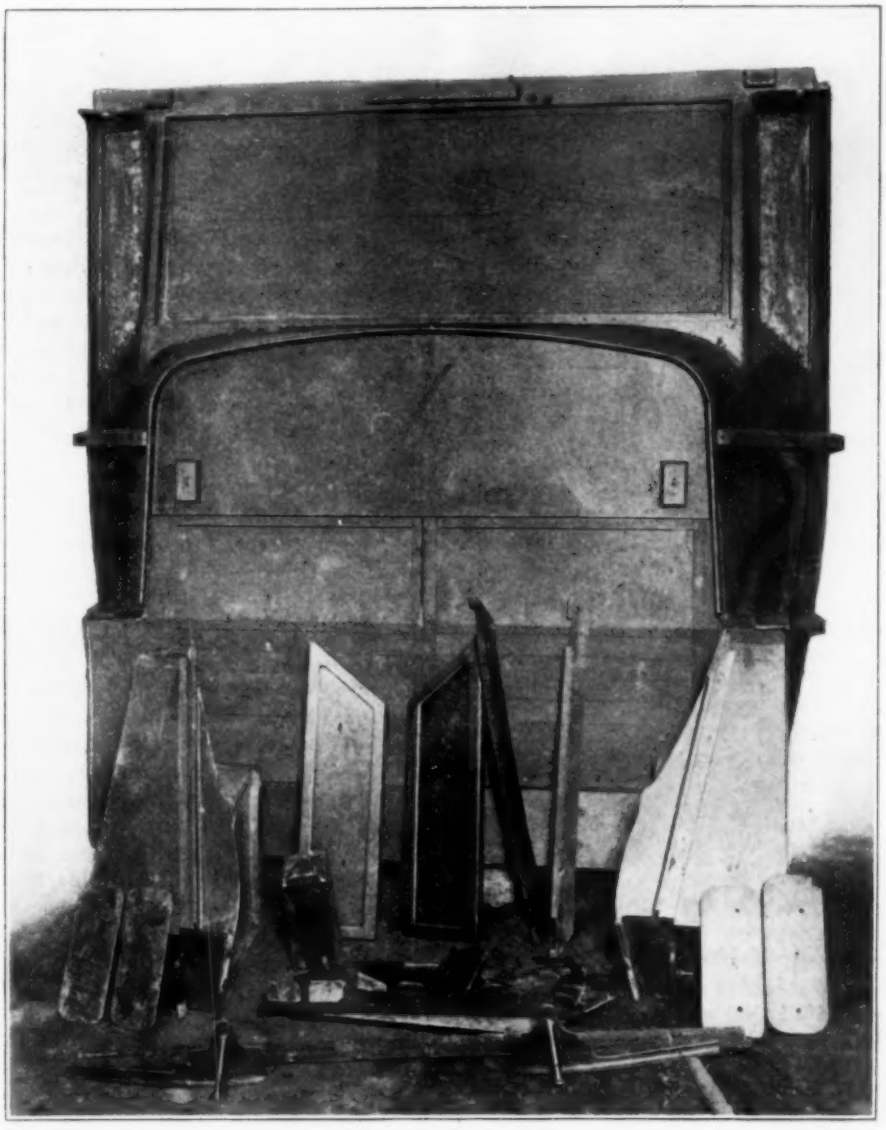


FIG. 5—THE WOOD PATTERN IS FITTED ON A SUITABLE FOLLOW BOARD—THE COPE IS RAMMED FIRST, ROLLED OVER, THEN THE DRAG IS RAMMED AFTER WHICH THE ENTIRE MOLD IS ROLLED BACK AND HANDLED IN THE USUAL MANNER

are connected by a single runner basin served by one ladle. The gates in the windshield section are cut in the cope, two gates from each sprue enter both the upper and lower part of the casting. The gates of the main body of the cowl are approximately 3 inches wide and enter the casting at two points as shown at *C* Fig. 4. The metal for the windshield section is taken from the furnace first and has a chance to cool somewhat while the other two ladles are filling.

A discrepancy in the uniform contraction was noted in the first few castings made. The wood pattern originally was designed for a contraction allowance of 7/32-inch to the foot, but after the casting was made it was found to be 3/8-inch too long. The pattern was checked carefully and found to be correct. The casting then was checked in detail against the pattern and it was found that on the main portion of the cowl, due to the metal gripping the large exposed surface, the contraction was only 7/64-inch to the foot, while on the wind shield section the contraction ran the full 7/32-inch to the foot. In other words the casting presented two distinctive contractions. After this fact had been confirmed by measuring several castings, the pattern was adjusted to meet the condition and subsequent castings have conformed to the proper dimensions.

The alloy used in making these castings is that prescribed by the Society of Automotive Engineers, known as No. 30 and made of pure aluminum with a copper hardener ingoted and then recast. Each lot is analyzed to secure uniformity. The metal is melted in a Johnson oil fired, iron pot furnace shown in Fig. 6 having a capacity of 350 pounds. Pyrometer readings are taken from the time the metal begins to melt until it attains a temperature of 1500 degrees Fahr. It

then is transferred to ladles pre-heated over the waste gas from the furnace and the metal enters the mold at approximately 1450 degrees Fahr. The average time of melting a heat of 350 pounds is 2½ hours.

Another interesting casting made for this auto stage is an aluminum window frame 24 x 26 inches presenting an average section of ⅛-inch metal. This casting, less than 3 pounds in weight, is made from a match plate in a special aluminum flask and a production of 100 pounds per man per day is maintained.

The company makes a specialty of high grade bronzes, brass, aluminum,

FIG. 6—WITH THE AID OF A PYROMETER THE TEMPERATURE OF THE METAL IS CONTROLLED CLOSELY—IT NEVER IS ALLOWED TO GO ABOVE 1500 DEGREES FAHR.

and other miscellaneous nonferrous alloys with special attention to acid-resisting metals and high grade bearing bronzes. The molding floor 50 x 125 feet is devoted about half to core room and tub molding and the remainder to heavy floor work. In addition to the Johnson furnace the melting equipment consists of a special gas fired furnace for melting tin, lead and other metals with a comparatively low melting point; two Schwartz oil fired furnaces of 1500 and 6000 pounds capacity respectively shown in Fig. 6 for melting brass and bronze alloys. The heavy molding floor is served by a 5-ton travelling crane and is provided with a pit 20 x 20 x 6 feet in which large castings are made. A special pit and equipment is provided for casting shaft liners on end. The shipping and cleaning departments are fully equipped with labor saving machinery.

Research Covers Alloy Age Hardening

Results of research on the constitution and age hardening of alloys of aluminum with copper, magnesium, and silicon in the solid state were reported by Marie L. V. Gayler, British National physical laboratory, in a paper presented at the meeting of the British Institute of Metals held at Swansea, Sept. 20 to 22. The following conclusions were drawn by the author:

In the ternary system—copper, magnesium-silicide, aluminum—the solubility of each of the compounds $CuAl_2$ and Mg_2Si in solid aluminum is affected by the presence of the other, both compounds being practically insoluble in aluminum at 250 degrees Cent., while at the higher temperature of 500 degrees Cent. the solubility of both is also reduced.

The age hardening of alloys containing copper and magnesium-silicide is due to this difference in the solubilities of both the compounds $CuAl_2$ and Mg_2Si in solid aluminum at high and low temperatures. It cannot be said that the age hardening is due in particular to the presence of one compound only. Alloys of aluminum containing copper or Mg_2Si only possess this property of age hardening after quenching, but of the two, those alloys containing Mg_2Si show the greater age hardening. However, when both copper and magnesium silicide are present the difference of the solubilities of these compounds at high and low temperatures is changed, and this increase or decrease in solubility depends entirely on the fact that both constituents are present together. But evidence leads one to suggest that of the two constituents Mg_2Si plays the predominant part.

The age hardening, which it is possible to obtain from an alloy with the percentage of one constituent fixed, depends on the solubility of the second constituent in the alloy at high temperatures. This age hardening effect appears to reach a maximum when the maximum amount of the second constituent, which can be held in solution at high temperatures, is present.

After being age hardened at room temperature, the first effect of further heat treatment is a softening which is followed by a subsequent increase in hardness and tensile strength and a rapid fall in percentage elongation. This effect is probably due to the process by which both compounds tend to come out of solution.

Derived differential heating curves of alloys quenched from 500 degrees Cent. but not aged, containing 0.81 per cent Mg_2Si with 6 per cent, 3.7 per cent, and 1.5 per cent copper, respectively, show three critical points. The highest probably is due to the precipation of copper, the second to that of Mg_2Si; no explanation is offered for the lowest critical point, which apparently takes place at constant temperatures.

Molds Seventy Years

Examples of longevity and long service are fairly common in the British metal trades. Many firms have in their employ men who have been working for them 40, 50 and 60 years. The foundry trade can show some remarkable instances. Benjamin Worton has just completed 71 years' work as a molder with the Cannon Ironfoundries, Ltd., Deepfields, near Bilston, Staffordshire. He is now 80 years of age and comes of a long lived stock. His mother lived to the age of 94 and his grandmother to the age of 104 years.

During the major part of his life Mr. Worton has been engaged in molding Dutch stoves and camp ovens. He still is making molds, and claims to be the oldest molder in the country.

Tillbury Iron Works has succeeded O. J. Cavanagh & Co., Tillbury, Ont.

Aluminum Melting Practice-III

Use of Covers and Fluxes To Prevent Oxidation—Metal Affected by Kind of Melting Pot Employed—Refractories for Reverberatory Furnace Linings—Action of Gases on Molten Metal Explained

BY ROBERT J. ANDERSON

FLUXING covers are used to a slight extent in melting aluminum alloys in foundry practice for the purpose of preventing oxidation, although the general tendency is toward the elimination of both covers for melting and fluxes for cleaning prior to casting. The use of a molten flux cover consisting of a mixture of salts, which will dissolve aluminum oxide or not, should be effective in preventing oxidation, although the cost may exceed the metal saving, and such a cover will be a nuisance in melting. The use of a molten flux cover should also tend to prevent the occlusion of gases by liquid aluminum and aluminum alloys. Solid covers made of plumbago are rarely used on crucibles in either pit furnaces or crucible furnaces when melting aluminum alloys, but it appears that the melting loss would be less if a cover were used in the furnaces, because the metal would be effectively protected from the products of combustion. Some melters have employed covers of charcoal, or of charcoal and sawdust for the purpose of maintaining a reducing atmosphere over the surface of the metal and thereby prevent oxidation. This practice is based on the principle that an excess of carbon in a restricted air supply will burn to carbon monoxide, thus excluding oxygen. However, it is a matter of considerable conjecture as to what effect both carbon monoxide and carbon may have upon liquid aluminum at melting temperatures.

With regard to molten and other flux covers, a variety of materials have been employed but not extensively in large plants. Zinc chloride and ammonium chloride are useless as flux covers because they volatilize rapidly. The usual molten flux cover consists of a mixture of salts which is liquid at, or preferably below, the normal melting temperature. Thus, a mixture of 60 per cent potassium chloride and 40 per cent cryolite has been employed. Sodium chloride has been used as a liquid cover in melting aluminum in reverberatory furnaces for casting into rolling ingots and in melting aluminum alloys in foundry practice. Borax, a mixture of sodium chloride and borax, a mixture of sodium chloride and calcium fluoride, and complex mixtures of a number of salts including potassium chloride, sodium chloride, lithium fluoride, sodium carbonate, etc., have been used for the prevention of oxidation on melting.

Hill* and his co-workers have examined the effect of melting commercial No. 12 alloy under boric oxide for 30 minutes; it is stated that the aluminum oxide content, as determined by Rhodin's method, was reduced from 2.27 to 1.70 per cent by this treatment. These investigators point out that it is conceivable that on melting a metal under a molten cover, which dissolved metallic oxides, the metal would have its oxide content lowered by solution in the covering, which would in turn cause a diffusion of the oxide from the interior portions richer in oxide. Thus, in time, an appreciable quantity of oxide might be dissolved in the molten cover.

Although the object of molten covers is more frequently for the purpose of preventing oxidation rather than for dissolving out aluminum oxide, it is evident that such covers fail in their purpose if they are readily penetrable by gases. Hill and his co-workers state that many of the common coverings are readily penetrable by hydrogen. The molten covers of sodium chloride or glass used in brass practice evidently have some value in reducing zinc losses due to volatilization. In aluminum melting, it would appear that a suitable molten cover should tend to make oxidation less rapid, and also protect the metal from other interactions with the constituents of furnace atmospheres, as well as to prevent gas occlusion.

In atmospheres containing oxygen and nitrogen, the effect of rapid melting would be to result in lower dross losses than with slow melting, other things being the same. Soaking of the metal should be avoided since the melting loss is a function of the time the metal is held in the furnace. Rapid melting and prompt pouring of the metal from the furnace are essential if the oxidation losses are to be kept low. This does not mean that when melting a 100-pound heat in 15 minutes in an open-flame tilting furnace the dross losses will be as low or lower than when melting a heat of the same size in 45 minutes in an iron-pot furnace. It simply implies that for a given furnace, the dross losses will be lower with more rapid melting and less exposure to oxidizing gases.

In most plants, melting is done only in the day time, especially in foundry practice, and the first heat in the morning will require, for most furnaces, about twice the fuel consumption of successive heats. Moreover, a fuel which will give a greater melting speed than a second fuel may prove more efficient on a cost basis even although the second fuel is cheaper on the basis of calorific power per unit. Furnaces which may be recharged immediately after pouring a melt have an advantage over furnaces such as pit furnaces which must lose heat while the crucible full of metal is being poured. A method for conserving heat and consequently for increasing melting speeds which has been applied to both brass and aluminum-alloy melting in electric furnaces, that merits attention, is the practice of charging the furnace with cold metal after the last heat at night and allowing the metal to absorb part of the furnace heat. In the morning the temperature of the interior of the furnace will be found substantially higher than if no metal were charged, and the first heat will require less time for melting than when starting with a cold empty furnace. This method may evidently be applied with advantage to furnaces other than electric furnaces. In one plant, in the case of reverberatory melting of aluminum for casting into rolling ingots, it is practice to keep a heat in the furnace over night by holding the temperature with one or two burners and just sufficient fuel supplied to keep the metal liquid.

The amount of dissolved gas and the dross loss are a function of the temperature and, to a less extent, of the time of melting and the constitution of the furnace atmosphere. The rate of melting will be affected by the temperature and by the size of the pieces melted. If the pieces of metal charged are small, they can be melted more rapidly than large pieces. In iron-pot furnace practice, the speed of melting can be increased substan-

*Hill, C. W., Thomas, T. B., and Vietz, W. B., Investigation of Brass Foundry Flux, paper before the Am. Inst. of Min. and Met. Engrs., Columbus meeting, October, 1920.

tially by the use of a molten heel in the pots, while in reverberatory and electric furnace practice, continuous rather than intermittent heats will be found advantageous in this respect.

The materials employed in making up heats are necessarily variable depending upon local conditions, although most melters endeavor to adhere to a more or less standard charge in which the same relative percentages of materials are used in successive heats. In foundry practice, the object desired is the preparation of a liquid alloy and superheating it to the correct pouring temperature in the shortest possible time with the lowest melting loss. Where metals of high melting point of the order of nickel and manganese are to be alloyed with aluminum the addition should be made by the use of an intermediate alloy rather than by the substantially pure metal. When the solid cold metals are added to liquid aluminum, as is entirely feasible with zinc and tin, the temperature of the aluminum must be raised unusually high and the melting period greatly prolonged, or both, in order to affect solution. A low melting-point metal will go rapidly into solution at normal melting temperatures. Some metals, such as copper and iron, can be readily added in the solid state with entirely satisfactory results provided small pieces are used. Large pieces require an excessively long time for solution.

Borings Increase Dross Losses

The average foundry charge consists of primary aluminum pig, secondary aluminum-alloy pig, foundry scrap, and the necessary additive metal usually in the form of an intermediate alloy. Borings and related fine scraps should not be added to foundry melting charges because they are certain to increase the dross losses. Such scraps should be run into pigs before charging. As a rule, small pieces of scrap should be poked down beneath the surface of a liquid bath, and small scrap should not be charged as such into an empty furnace because too great a surface area is thereby exposed. Oxidation losses are invariably more severe when loose scrap is charged into an empty furnace than when charged to a molten heel. The practice of charging foundry-floor sweepings and small pieces of metal from the cleaning and chipping room must be regarded as bad practice. These materials should be run into pigs if they are very small.

The principles governing the make-up of alloys in die casting and permanent-mold casting practice are substantially the same as in foundry practice, except that generally the alloys are first made up in an alloying furnace, and then cast into pigs. The pigs are then delivered later to the die-casting machine for remelting.

Table I

Heating Aluminum in Different Crucibles

Crucible	Al_2O_3, per cent	Fe, per cent	Cu, per cent	Si, per cent — Total	Si, per cent — Graphitic
Original ingot	0.35	0.34	0.10	0.30	....
Pressed steel	0.40	0.50	0.12	0.30	....
Acheson graphite block	0.40	0.29	0.10	0.23	....
Dixon graphite-clay	0.90	0.34	0.10	0.25	....
Magnesia	1.30	0.36	0.13	0.30	....
Clay	2.70	0.40	0.10	0.94	....
Porcelain (glazed)	7.50	0.45	0.10	3.00	2.80
Sand	11.40	0.30	0.10	6.40	5.80
Fused silica	14.70	0.30	0.10	11.30	11.00*

Based on Hill, Thomas, and Vietz.
*Crucible turned black in contact with metal.

The question of the material composing the melting pot, or of the furnace lining in the case of open-flame furnaces, is one of especial significance in the melting of aluminum and its light alloys because of the great chemical activity of aluminum. Some preliminary work on the effect of heating aluminum in crucibles of different kinds has been carried out by Hill* and his co-workers. In these experiments commercial aluminum was melted in an oxidizing atmosphere in different kinds of crucibles, without stirring, at 750 degrees Cent. It was shown that, even with prolonged heating on exposure to air, aluminum does not take up much oxide from surface contact with the atmosphere. On prolonged heating in refractories containing even combined silica, reduction takes place with the introduction of alumina. The results are given in Table I. In foundry practice, light aluminum alloys are melted both in plumbago crucibles and in cast-iron melting pots. Steel has been tried for melting pots but is practically useless for this purpose because the rate of attack of liquid aluminum on steel is very rapid.

Cast Iron Melting Pots

In considering cast-iron pots for melting aluminum alloys, the first item of interest is the composition of the iron. Gray cast-iron and so-called semi-steel pots are used almost exclusively, and pots made of these irons are fairly satisfactory. The life of an iron pot is dependent upon a number of factors of which the chemical composition appears to be a relatively unimportant one although this aspect of the subject has not been examined thoroughly. The conditions surrounding the melting of aluminum alloys in cast-iron pots merit careful attention because of the large tonnage now melted in iron-pot furnaces. The life of an iron pot is dependent, among other things, upon the rate of dissolution of cast iron in liquid aluminum alloys, upon the quality of the pot, upon the temperatures employed, and upon whether washes or coatings are used on the inside and outside of the pot. The principal advantages which arise from using iron pots rather than plumbago crucibles for melting lie in the fact that larger capacities can be obtained with the former, the speed of melting is more rapid, and a molten heel can be employed. The principal disadvantage results from the fact that iron pots are liable to give rise to hard spots in the resultant castings unless the melting is carefully handled. These may be overcome by scraping and cleaning the inside surface of the pots so that no accretions build up.

As to the chemical composition of cast-iron pots, it has been said that gray cast iron and so-called semisteel are generally used. A foundry company which specializes in the production of cast-iron pots for aluminum-alloy melting makes pots of the following typical analysis; 0.50 per cent combined carbon, 3.15 per cent total carbon, 0.44 per cent manganese, 0.269 per cent phosphorus, 0.198 per cent sulphur, and 2.57 per cent silicon. Iron pots will last from 8 to 12 days melting 9 to 12 hours per day, and most foundrymen prefer to remove old pots after the eighth day rather than to run the risk of losing a heat owing to a breakout. Before a new pot is put into service it should be carefully inspected for blows, draws, and other foundry defects as well as for evidence of patching, otherwise a faulty pot may be placed in the furnace and failure will take place after a few

*Hill, C. W., Thomas, T. B., and Vietz, W. B., Investigation of Brass Foundry Flux, paper before the Am. Inst. of Min. and Met. Engrs., Columbus meeting, October, 1920.

heats. The use of washes and coatings for cast-iron pots for the purpose of prolonging their life is generally recognized as desirable, but the main difficulty comes in securing a suitable wash. Various high temperature cements, magnesia, fireclay, and other materials have been employed with indifferent success, but it is reported that whitewashing the inside with slaked lime has given good results. This wash is also useful on the inside of iron carrying ladles. A 0.5-inch thick coating of alundum cement has been found useful for certain die-casting pots. The use of coatings on the outside surface of cast-iron pots for the purpose of preventing oxidation and protecting the iron from the cutting action of the flames has been suggested and used by some founders. The main difficulty lies in obtaining a coating which will adhere to the pot. Some high temperature cements have been tried for this purpose.

Iron Content Higher

Iron pots fail in service through defects in the original casting which escape inspection, through stretching and scaling and through breakouts from the inside where the pot becomes thin in spots owing to the attack of the aluminum. In iron-pot melting, the iron content of the resultant alloys is always higher than when melting in crucibles or in contact with a refractory furnace lining owing to the dissolution of iron by the aluminum. If any iron oxide is present on the surface of the pot, or if iron oxide falls into the aluminum from the flange of the pot, then the reaction

$$Fe_2O_3 + 2Al = Al_2O_3 + 2Fe$$

takes place. The reduced iron alloys with the aluminum and the aluminum oxide is found in the dross.

A relatively small tonnage of aluminum alloys is melted in plumbago crucibles, either in pit furnaces or in crucible furnaces, although crucibles are used by a great many small foundries. The composition of the crucibles made by different makers may vary considerably. A so-called plumbago crucible of a good standard grade is made of a mixture of about 40-55 per cent graphite, 5 per cent silica sand, and the remainder clay of the Klingenberg grade or equivalent. The life of plumbago crucibles used for melting aluminum alloys may, in general, be expected to be longer than when used for brass and bronze, owing to the lower melting temperatures employed, although the corrosive action of aluminum alloys is greater than that of brass and bronze. In contact with siliceous materials, aluminum will reduce silica at the normal melting temperature according to the formula

$$4Al + 3SiO_2 = 3Si + 2Al_2O_3$$

The reduced silicon enters the aluminum, and aluminum oxide is formed. When melting aluminum in plumbago crucibles, if the metal is allowed to reach a high temperature and then stirred so that particles of graphite are scraped off, some aluminum carbide, Al_4C_3, is formed.

The life of crucibles may be prolonged by the use of a wash or coating, or by giving a new crucible an initial heat of brass or bronze. Plumbago crucibles to be used for aluminum alloys should be given one heat of brass or bronze* as the aluminum has a tendency to soften a new pot; when used thereafter for aluminum alloys exclusively, a life of about 100 heats will be obtained. The life of a crucible used for melting aluminum alloys** can be considerably lengthened by using it first for a couple of heats of copper or bronze because the melting temperature for aluminum alloys is not sufficient to harden the pot. When not hardened, the crucible wears away particularly at the top where the tongs or furnace tools come into contact with it. After melting in a plumbago crucible, any metal left in the bottom after pouring should be removed since small frozen buttons in the bottom will cause cracks and leakage because of expansion on reheating. Vickers*** states that plumbago-clay crucibles should be given an internal coating of fireclay since it is highly desirable that the metal be kept out of contact with carbon. It is stated that the fire clay should be of good grade, and that the wash is made up by first passing the dry clay through a fine screen and then mixing it with water containing sodium silicate to a creamy consistency. The wash is then painted on the inside of the crucible, after which it is allowed to dry slowly so as to avoid blistering.

In a recent patent,**** crucibles of graphite, iron or steel, or clay, for use in melting aluminum and aluminum alloys, are provided with an internal coating of aluminum bronze varnish before each melting operation. The varnish is burned out of the coating by heating slowly to about 400 degrees Cent. The aluminum coating becomes oxidized during the melting operation.

In the case of tilting and stationary open-flame furnaces, reverberatory furnaces, and electric furnaces, aluminum and its light alloys are melted in contact with refractory linings and bottoms. The question naturally arises: What is the correct refractory to employ?. In this connection, there are several things to be carefully studied, that is the chemical composition of the material melted; the chemical composition of the refractory and its general properties; interaction of aluminum and the constituents of the refractory; and cost of the refractory. Given adequate data, the most suitable refractory lining for a given installation can be readily determined. The conditions surrounding the life of the refractory lining of the furnace shell in pit furnaces, crucible furnaces, and iron-pot furnaces as contrasted with the lining in open-flame furnaces, reverberatories, and electric furnaces are similar, but in the three latter types the refractory must withstand the corrosive action of liquid metal and mechanical abrasion due to charging in addition to high temperatures and rapid changes in temperature.

Rammed Lining Employed

Generally speaking, refractory fireclay bricks have been used for lining open-flame furnaces although in recent years there has been a tendency to employ a great variety of materials for this purpose. In open-flame tilting furnaces, a rammed lining of ganister and fireclay has been employed with considerable success, and the life of this material is long when aluminum alloys are melted. Carborundum firesand is employed for open-flame tilting and stationary furnaces and for the hearth in some electric furnaces. Magnesia firebrick have been used in Europe prior to 1900 and later for lining reverberatory furnaces for aluminum melting. No published accounts have appeared. Both bauxite brick and chrome brick have been suggested for use in lining furnaces for aluminum and aluminum alloys but no actual applications have been made so far as is known. The main disadvantages of these refractories is their high initial cost. Carbon brick, and zirkite brick have also been used for lining some open-flame furnaces. Carborundum and related products have been recommended as suitable refractories for lining aluminum and aluminum-alloy melting furnaces.

Of course, in actual practice, the lining life varies greatly depending upon the material used, and upon whether the furnace is run constantly or is allowed to cool considerably before another heat is charged. Any siliceous lining will be attacked by liquid aluminum although

*Anon., Production of aluminum castings, THE FOUNDRY, vol. 33, 1908-1909, pp. 139-144.

**Anon., Hints on casting aluminum, THE FOUNDRY, vol. 34, 1909, p. 16.

***Vickers, C., How we may conserve our metal resources, THE FOUNDRY, vol. 45, 1917, pp. 209-214.

****English patent 146,841, 1919.

the actual corrosion because of this is usually not so great as the abrasion due to mechanical blows on charging, or the wear due to spalling on heating and cooling.

The effect of the pressure of furnace gases passing over liquid metal is of interest mainly in melting aluminum-zinc and aluminum-copper-zinc alloys high in zinc. In the operation of open-flame tilting furnaces on brass, some melters close all openings to the furnace as much as possible so as to maintain a pressure over the alloy. The net practical effect of this is to prevent the volatilization of the zinc from brass, since in a closed chamber containing metal in the liquid and vapor phases the effect of increased pressure is to condense part of the vapor. Since operating melting temperatures for aluminum alloys should be kept much lower than for brass, the volatilization of zinc should not be dangerous. On the other hand, where zinc-containing aluminum alloys are melted in open-flame furnaces and especially where these furnaces are driven very rapidly, an increased pressure in the melting chamber can, no doubt, be advantageously employed.

Regarding the effect of the velocity of furnace gases passing over liquid metal, it may be stated that the greater the velocity with which gases pass through a furnace the greater the volatilization losses. This factor is of importance chiefly in melting brasses and related alloys high in zinc, and it does not assume much importance in aluminum-alloy melting practice. Briefly, the lowest volatilization losses would come in a furnace where the gases moved the slowest. Where gases pass through a furnace too rapidly, there is insufficient time for the heat to be transferred to the metal thereby resulting in slow melting and poor fuel efficiency.

Close Openings to Furnace

The use of high-pressure gas in melting practice, is advocated for the purpose of increasing the melting speed. High-pressure gas burners have been applied to furnaces melting aluminum alloys, but no figures are available as to gas consumption or melting loss on a comparative basis with low-pressure burners.

The effect of the size of furnace upon fuel consumption is of much importance. Sufficient data are available based on operating tests over a long period of time to show that there is a substantial improvement in fuel efficiency with increase in the size of a furnace. This fact is generally true of all types of furnaces.

In aluminum-alloy melting in oil-fired furnaces, air atomization is generally used. Steam atomization is not used so far as is known, although there is evidently no reason why it cannot be so employed. Steam atomizing burners are used on some brass furnaces. In all non-ferrous metal-melting furnaces, the oil atomization should be accomplished with the minimum amount of air. With any type of burner using air atomization, it is imperative that the pressure of both air and oil be steady, since otherwise fluctuations occur in the flame, and fuel efficiency cannot be had. A burner should be chosen which will burn the fuel efficiently, yielding an atmosphere low in free oxygen. Of course, if the air and oil pressures on the line fluctuate widely, no type of burner can be expected to operate satisfactorily. Irrespective of the type of furnace and the fuel employed, ample combustion space should be provided. In furnaces fired by liquid or gaseous fuel, time is required for the diffusion of oxygen with the gas or atomized oil, and burners using high-pressure air may carry the fuel out of the furnace before this has taken place. Often, the combustion space in a furnace is sufficiently large but such a large volume of fuel is supplied, that much of the fuel is burned outside of the furnace and low fuel efficiencies result. Too small or too large combustion space is due to improper design, and either one is serious from the point of view of melting efficiency. Where the combustion space is too large, the furnace is too large, and heat is lost by surface radiation from the walls. Where the combustion space is too small, the fuel will be burned partly outside the furnace, in the stack, and fuel is lost.

How and Why in Brass Founding

By Charles Vickers

Overcoming Cracking in Thin Castings

We are making fishing rod reels of cast aluminum and have about 50 per cent rejects due to cracks that develop. The wheel is a spidery object consisting of a thin, flat disc with a small hub in the center, and lightened by a number of equally spaced holes. The rim of the disc, carries a deep trolley on which to wind the line, and this is formed by two thin rims, held to the center disc by eight equally spaced U-shaped connections. The whole casting is extremely light and delicate. The difficulty is cracking of the U-shaped pieces at the disc connection. Formerly the thin rims also cracked but we have overcome that by adding two slightly heavier outer rims and gating them to the wheel rim. These are cut off when the castings are cleaned. We gate on top of the hub with a straight sprue, ⅞-inch in diameter. The metal thickness is ⅛ of an inch.

Frequently the cracking of thin, delicate castings of aluminum alloy is caused by using too large gates or sprues; and the first experiment to make here is to reduce the size of the sprue. Such a thin casting requires no feeding. The metal thickness is uniform, therefore, a drop gate no larger than a lead pencil should be placed on the hub. This will be 5/16 inch in diameter, and if a bushed head is put on the cope, widened out to a funnel large enough to hold enough metal to pour the casting, the latter ought to run. The head should be knocked off just after pouring and while it is liquid. Such methods have in numerous cases stopped the cracks on thin wheel-shaped castings. Should this method fail, add about 1.25 per cent iron to the alloy, using tinplate scrap, or should there be difficulty introducing the iron, increase the copper to 10 or even 12 per cent. Some change such as suggested, with a change in gating, will overcome this difficulty.

Method Recommended for Gating Brass Rings

We are making brass ring castings 32 inches diameter, 16 inches deep and ⅝-inch thick. The castings in the rough appear perfect, but following a cut on the machine, holes are found about ¼-inch diameter and ¼-inch deep, which are bright and clean inside, the number of the holes varying with different castings. We have tried different alloys, such as 4 per cent each of tin, lead and zinc to 88 per cent copper; 8 tin, 2 lead and 2 zinc to 88 copper; and 10 tin, 10

lead to 80 copper, and we have poured them with basin and plug and in green and in dry sand, with no better results. The metal is melted in coke-fired pit furnaces.

A complete discription of how to gate and cast these rings was given in the December 1910 issue of THE FOUNDRY page 161. and if back issues of THE FOUNDRY are available we suggest a study of the article. These rings usually are made in green sand and a number of castings of lessening diameter can be molded in one flask. The best place to gate them is at the bottom, and they should be poured *two up*, that is, with two pots, or ladles, on opposite sides of the flask. To form the gate at the bottom, use dry sand runner cores, molded in the drag with the pattern; do not cut the runner into the side of the ring, but have it on the bottom edge thereof, and armor the sides of the ring where the metal will flow through with dry sand cores, if the molding sand is at all *close*.

Enlarge the diameter of the sprue through the cope section, but keep it down to an inch, or, a little over, from the joint to the bottom runner cores, so the head can be kept filled while pouring. Put about 4 ounces of phosphor copper into the metal, for each hundred pounds and place it in the bottom of the crucible with the cold metal and cover with charcoal; get the metal hot, skim it and stir it and scrape the sides of the pot inside to bring up adhering dross, and pour with lively but not excessively hot metal.

Stop Aluminum Castings from Cracking

We have been casting some 6-cake electric waffle plates. They are 8 x 9½ inches on the surface, with a 2½-inch rim all around. The plate is 3/16 inch thick at the bottom of the groove and ⅜-inch thick through the bosses. Some of these plates have been cracking through the center. The metal consists of ingot aluminum 25 per cent; scrap consisting of old aluminum pots etc., to about 75 per cent. We find that if the molds are shaken out soon after pouring, the castings do not crack as much as when left to cool in the molds.

The causes why aluminum castings crack are always a puzzle, and no single solution will fit all cases. Sometimes secondary material in the shape of rerun ingot containing 1 per cent upwards of iron will produce castings free of cracks, when castings from new ingot metal runs strongly to cracks. Sometimes a little zinc, between 1 and 2 per cent *drives out* the cracks. Then of two aluminum alloys of identical analysis, one will be free of cracks and the other will crack freely. In the latter case, no doubt the presence of aluminum in the one alloy is the cause of the cracking.

In the case under discussion it would be advisable to have one or two analyses made to discover the composition of the metal being used. If new aluminum ingot it being used and the pots are rolled material, the aluminum may be too soft and the addition of copper as a hardener might eliminate the cracks. In the absence of an analysis it is not possible to suggest changes in composition because it would be nothing but guesswork, and any changes would be just as likely to be going away from a solution, instead of going toward one.

Bale Nickel Scrap and Melt Under Cover

We are making nickel silver castings using rolled scrap stock of 18 per cent nickel, and are having great difficulty in getting sound castings, especially where the work is cored the castings come badly pitted. Is there any alloy we can add to the metal to remedy this difficulty?

It is doubtful if much success ever will be enjoyed melting down rolled scrap for castings. If the price of the castings has been based on the expectation of making them sound on the first melt of scrap the prospect cannot be regarded as pleasing.

We suggest baling the scrap as compactly as possible, that in melting, deepeners be used on the crucibles to entirely enclose the baled material and protect it from the flames. Use charcoal and a little borax as a covering, and melt and pour first into ingots. For the castings, remelt the ingots under charcoal; have the metal so hot that when an iron bar is immersed, vibrations distinctly will be felt. A little dissolved iron will do no harm. A few minutes before the metal is pulled, add about four ounces of 30 per cent manganese copper per hundred pounds of ingot.

When the metal is out of the furnace, handle it like yellow brass, pouring with sufficient rapidity to keep the heads filled all the time the metal is filling the molds. A good yellow brass molder will handle this alloy successfully, but the gentle art of casting yellow brass seems to be disappearing from our land.

Castings Are Dipped To Produce Colors

We should like to learn how to obtain rich, reddish or golden colorings on our small, square bodied valve castings.

To secure fine-colored castings, new metals should be used; an alloy of the following composition will yield beautiful, orange-colored castings.

	Pounds
Copper	88.00
Tin	4.00
Zinc	4.00
Lead	4.00

The cores should be *blown out* by plunging the castings while hot into water; half an oil barrel makes a good vessel for the purpose. The castings must not be taken from the sand red-hot and it probably wi" be necessary to experiment to find the correct temperature; they will have to be hot enough so that when the entire gate of castings is immersed, it will require a slight jolt against the side of the barrel to set them off. A good way is to lift off the copes a few minutes after they have been poured, and with a pair of tongs seize the gate so it will balance, then plunge the castings under water while holding the gate horizontally. Considerable skill is required in dipping castings to avoid a bath of dirty water mixed with sand. If the castings are left to cool in the sand the colors will not be so pretty as when they are dipped in water while hot. Iron must strictly be kept away from all mixtures expected to produce colored castings.

Aluminum Bottle Shaped Castings Crack

We are making aluminum castings resembling a beer bottle; about 7 inches long and 4 inches diameter, with the inside cored out. We are using No. 12 aluminum with some scrap and the trouble is the castings crack, although we make the cores as "rotten" as possible.

Possibly the manner in which the casting is gated is responsible for the cracking. A good way to gate a casting such as described is with pencil gates on the top, in the cope. When ramming the cope, mold up about four lead pencils like little risers all in a row on top of the casting and before lifting off the cope, cut a runner channel connecting all four and extend the channel to near the edge of the flask where it should terminate in a dish the same as if it were a regular gate cut in the drag. When the mold is finished put a frame or an extra half flask on top with a sprue cut and reamed so the metal will drop into the dish on top of the cope. The metal simply runs down the runner and drops through the little pencil gates into the casting cavity, and because there is no heavy masses of metal at the mold joint to pull on the casting this simple gate often stops cracking in the case of aluminum. If about one per cent iron can be added to the alloy, that also will materially assist in getting castings free of cracks.

Castings Made Without Heads

The Author Is Not Yet Prepared To Advance a Hypothesis Explaining the Apparent Phenomenon, He Merely States the Result of His Observations Extending Over a Considerable Period

BY E. V. RONCERAY

FOUNDRYMEN generally accept the fact that metals, in solidifying, decrease in volume and have demonstrated and built on it theories, to the effect that in the center of a cooling metallic mass there must be a cavity. It may be that this theory holds good for large masses, but in most of the cases observed in actual practice, the cavities found in castings may be attributed to other causes which a better practice is likely to suppress.

To obtain sound castings it is customary to put heavy feeding heads on the top of higher parts, and to also employ the well-known action of pumping for adding new metal. It is not uncommon to find cavities and porosities under feeding heads. The empiricism of this method does not satisfy progressive men, and the author has some hope that if such men are willing to observe and experiment on the lines that will be outlined, in the near future new laws will be observed governing the solidification of metal and the escape of mold-gas. This will result in considerable improvement, not only in foundry practice but also in other related industries.

The following history of the way the pouring of castings without feeding heads was originated will absolve the author from seeming to usurp a paternity which does not belong to him. The credit is due a great foundryman, E. Saillot, one of the managers at the author's works, and the originator of most of the improvements that the author has had the honor to present to the foundry world during these past twenty years. Mr. Saillot is a man of perspicacity and observation with an instinctive genius for engineering and foundry work.

About 1886 the foundry of the Western Railway Company of France was engaged in making white-metal brasses for axle-boxes. In experimenting with various ways of pouring them it was found that for some reason, of little weight for the question under discussion, better results could be obtained with a small metal head than with heavy risers. This suggested the idea to make tests on gun-metal railway castings to reduce feeding heads and risers. The reduction in bulk took place gradually and finally feeding was discontinued. However, covered risers still were

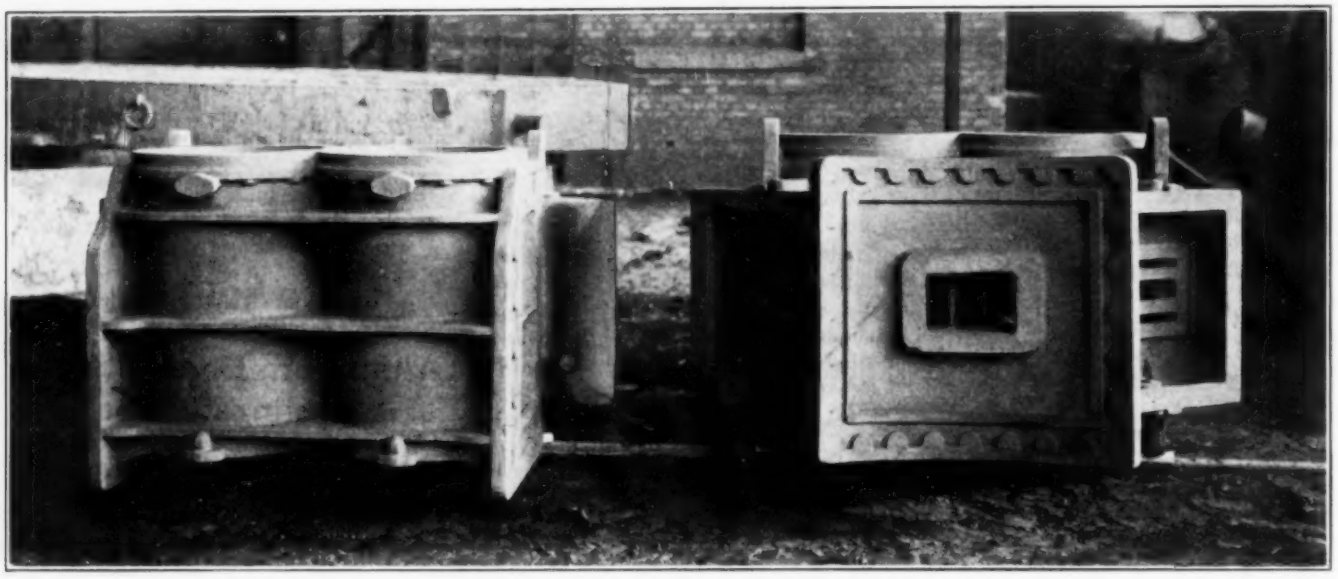


FIG. 1—LOCOMOTIVE CYLINDERS AT THE PLANT OF JOHN COCKERILL, SERAING, BELGIUM—THE METAL IS INTRODUCED THROUGH A SMALL GATE UNDER THE CENTER OF THE SADDLE FLANGE AS SHOWN IN FIG. 10

From a paper presented before the London branch of the Institution of British Foundrymen. The author, E. V. Ronceray, is head of the Ph. Bonvilliain & E. Ronceray, molding machine manufacturers, Paris, France.

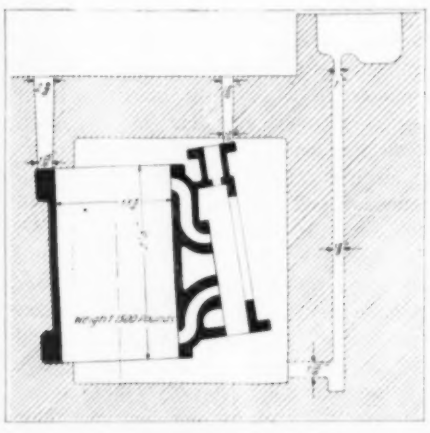


FIG. 2—A 1500-POUND LOCOMOTIVE CYLINDER CAST WITH A 1⅜-INCH RUNNER ENLARGED TO 1⅛-INCHES

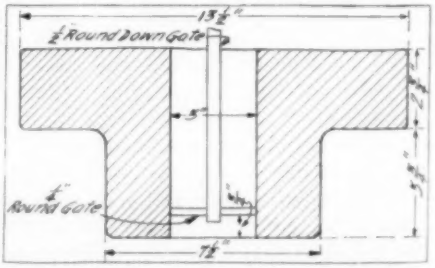


FIG. 3—SHAFT COUPLING POURED THROUGH TWO ¼-INCH DIAMETER GATES

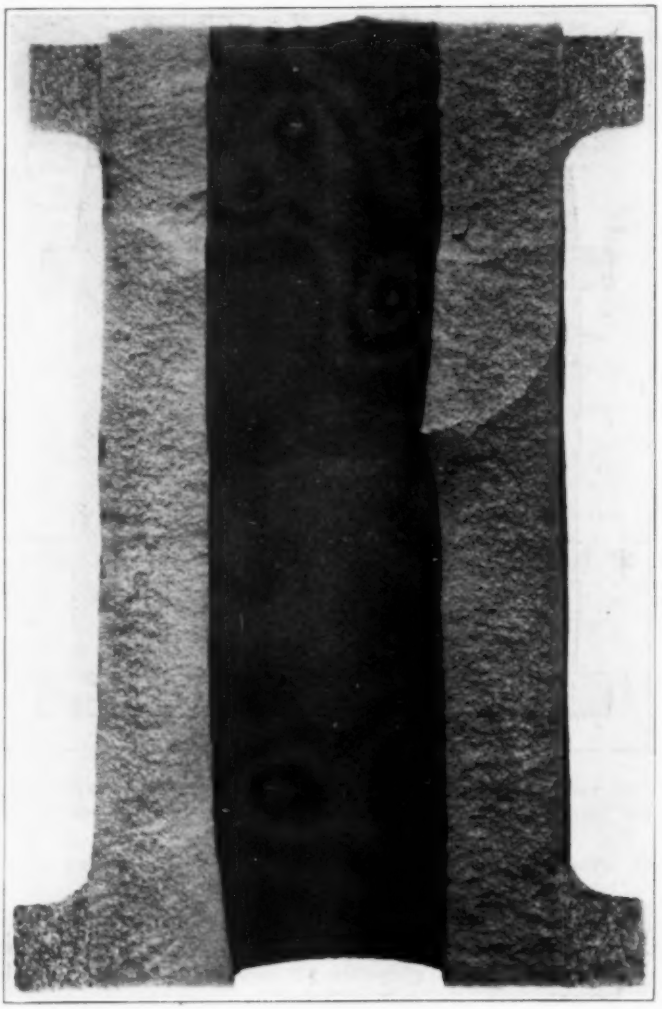


FIG. 4—TO THE LEFT—LONGITUDINAL BROKEN SECTION OF THE CASTING SHOWN IN FIG. 9—THE METHOD OF POURING THE ROCKER ARM AND THE SAME CASTING BROKEN TO SHOW THE HOMOGENEITY OF THE METAL ARE SHOWN IN FIGS. 6 AND 5, BELOW AND ABOVE, RESPECTIVELY

used, and the runners, though not so large as usual, were of ample size. This went on for a few years.

Passing through the foundry while a Webb gun-metal locomotive safety-valve body weighing about 225 pounds was being poured, Mr. Saillot, manager of the works at the time, saw the men on the point of stopping pouring because the gate did not take the metal as quickly as usual. One crucible was empty and a second one was ready. He ordered it poured since the mold was condemned and the metal might as well be poured in it as in ingot molds. Contrary to expectations the riser plugs did not lift, and an amount of metal about equivalent to the volume of risers remained in the pouring basin. A perfect casting was the result. While cleaning the casting it was found that the runner was partly closed by a piece of slag which had fallen from the crucible at the beginning of the pouring. The free section of clogged runner was about ½-inch square.

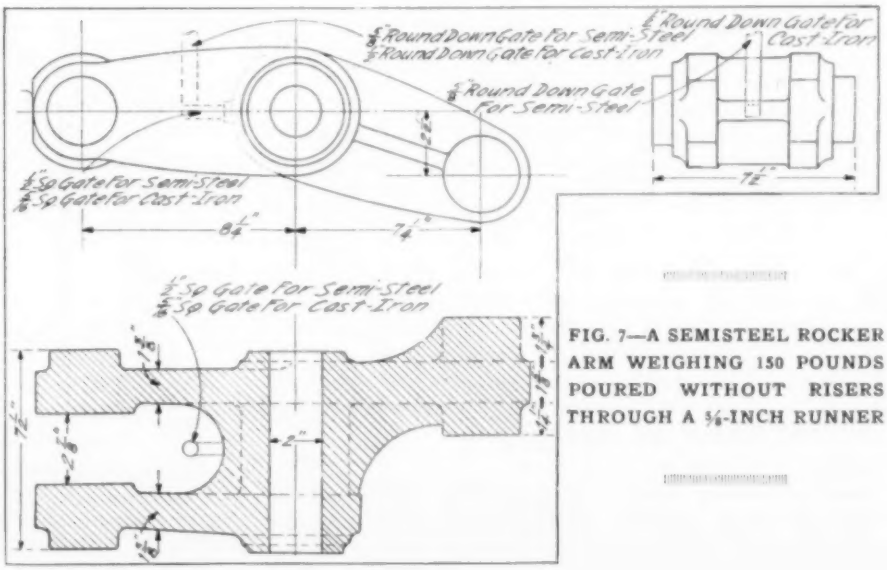
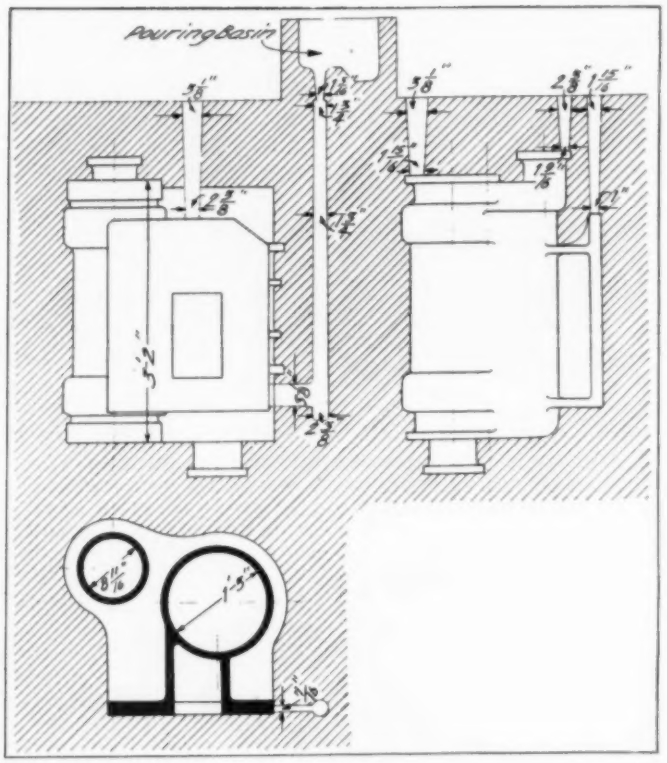

⅜" Round Down Gate for Semi-Steel
⅜" Round Down Gate for Cast-Iron
⅜" Round Down Gate for Semi-Steel
⅜" Round Down Gate for Cast-Iron
⅜" Sq Gate for Semi-Steel
⅜" Sq Gate for Cast-Iron
⅜" Sq Gate for Semi-Steel
⅜" Sq Gate for Cast-Iron

FIG. 7—A SEMISTEEL ROCKER ARM WEIGHING 150 POUNDS POURED WITHOUT RISERS THROUGH A ⅝-INCH RUNNER

Riserless Casting Made

Another mold was made without feeding heads, and an ordinary pencil used for making the runner. The result was perfect. The machining revealed no defect, and thereafter these castings were poured through runners of about ⅜-inch instead of ⅞-inch to one inch as before. The method was extended with success to locomotive slide-valves and axle-box bearings.

Machine molding was becoming known at this time. Cliche tables were filled with cliches where feeding heads, as used for hand molding, were provided, and the molds were poured on end. During the whole month Mr. Saillot had the feeding heads put



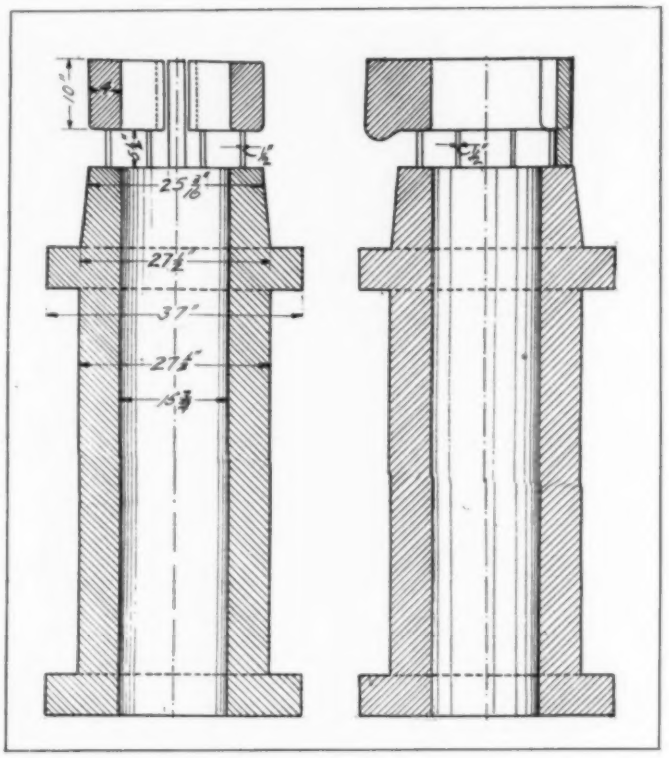


FIG. 8—METHOD OF GATING AND POURING 1-TON CYLINDER AT THE PLANT OF JOHN COCKERILL, SERAING, BELGIUM
FIG. 9—SECTIONS OF A 10-TON HYDRAULIC CYLINDER POURED THROUGH EIGHT ⅝-INCH DIAMETER GATES

downward. The loss, if anything, was less than before.

It must be mentioned that in this foundry molds were dried and metal was very hot. Later, the adoption of an oil furnace gave trouble until it was found possible to get the same temperature as with a clay crucible furnace. Hot pouring is most important, as it was proved in another case.

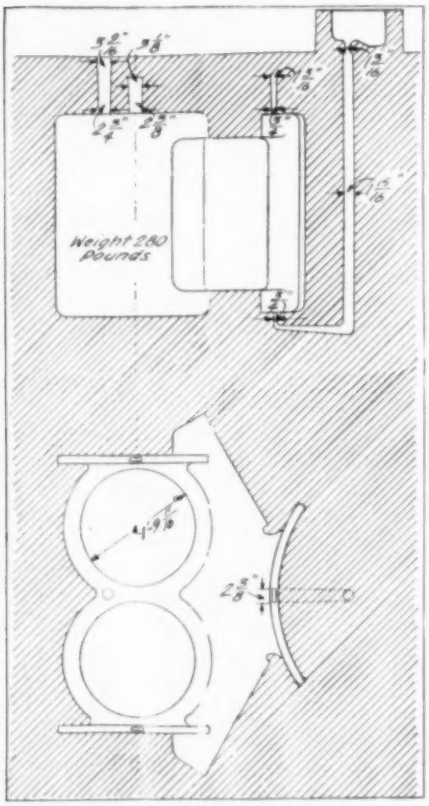


FIG. 10—METHOD OF GATING LOCOMOTIVE CYLINDER SHOWN IN FIG. 1 THE GATE IS ¾-INCH DIAMETER WHERE IT ENTERS THE FLANGE

In the iron foundry of the same company, brake blocks, oil boxes, and locomotive cylinders always had been poured without feeding heads—no person seemed to know why—but all other castings were made with heavy heads. The locomotive cylinders were poured horizontally with a flow-off that was closed after 200 to 300 pounds of iron had flowed through. Cylinder covers were poured on end and carried a large closed riser weighing about as much as the cover itself. The casting was sound, but in polishing it the metal looked darker near the riser, which easily can be explained by slower cooling at this place. No trouble was experienced pouring this same casting on its flat with a small gate in the center and no riser.

Large Castings

The foundry staff and men objected to the method when an order came for three wheel press cylinders, weighing from 5 to 6 tons; but Mr. Saillot insisted, and the first one was poured, heavy part in top, as show in Fig. 11. The runner was 40 x 40 m/m (about 1 9/16-inches square) and no risers or feeding heads were provided. The top came slightly flattened, but was put in regular service without any trouble. The two others were made in the same way, but with a runner only 30 x 30 m/m (1 3/16-inch square) and were perfect. Steamboat propellers 9 feet diameter were made similarly without trouble.

At this time machine molding was confined principally to small castings which did not require feeding heads.

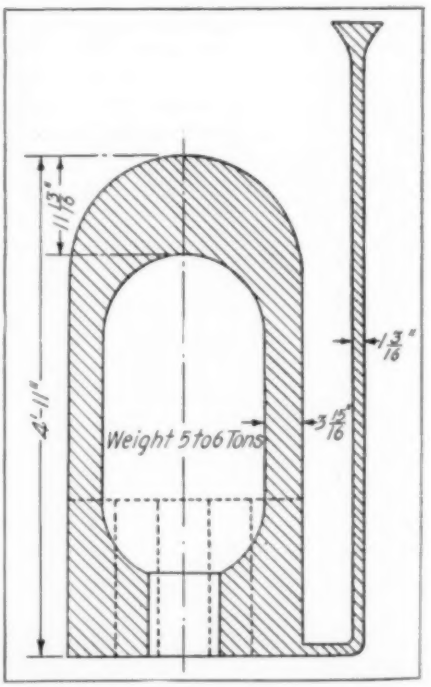


FIG. 11—WHEEL PRESS HYDRAULIC CYLINDER POURED THROUGH A SINGLE SMALL GATE AT THE BOTTOM AND WITH NO RISER ON THE TOP

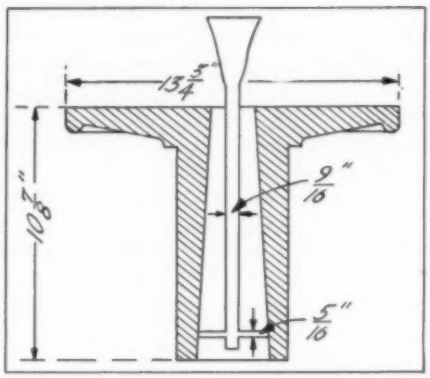


FIG. 12—WEIGHT OF CASTING 81 POUNDS. WEIGHT OF RUNNER 2¼ POUNDS. DIAMETER OF VERTICAL RUNNER ⅜-INCH. DIAMETER OF HORIZONTAL RUNNER ⅛-INCH

Moreover, we had more or less to follow the customer's views referring to the method of gating. We had not obtained sufficient knowledge or influence at this time to impose our own views. Machine molding was in its infancy, and, as can be imagined, we had enough wheat to grind in our mill in combating direct opposition to new processes not to split our efforts by taking up a side line in which probably our machines would be blamed for all inside shop failures.

Semisteel Shells

However, the opportunity arose during the war when it was necessary to make semi-steel shells with all speed. To make shells immediately on machines that already were installed in foundries, we devised a method of molding them on reversible split pattern-plates, and of pouring them on end. We recommended the omission of feeding heads and the use of a ½-inch runner on a 155 m/m (6-inch) shell weighing 112 pounds. We met considerable opposition from the War Office, and many foundrymen, but the scheme at last proved satisfactory. Had the molds been dried no trouble whatever would have been experienced, but a green sand mold presented many advantages and we strongly recommended it. Providing sufficient care was taken in mixing and ramming the sand, perfect shells were obtained, and their cost was considerably reduced by the saving in handling coal and metal. However, in the rush, this care not always was taken and troubles were thus experienced. Some foundrymen successfully made shells up to 200 m/m (9-inch) and larger by this method, which proves that technically it was correct.

Later when our demonstration foundry was put in operation we tried with alternations of success and failure to produce the same results on different shapes of castings, with the view to discover the causes and obtain data for determining sizes of runners in proportion to weight of castings. However, up to the present we have not fully succeeded in eliminating feeding in every case.

In publishing the result of these experiments in *La Fonderie Moderne* we felt that other people might be induced to take the same course, and from combined experience obtain some increase in common knowledge. The author wishes to emphasize that this system of slow pouring is not his

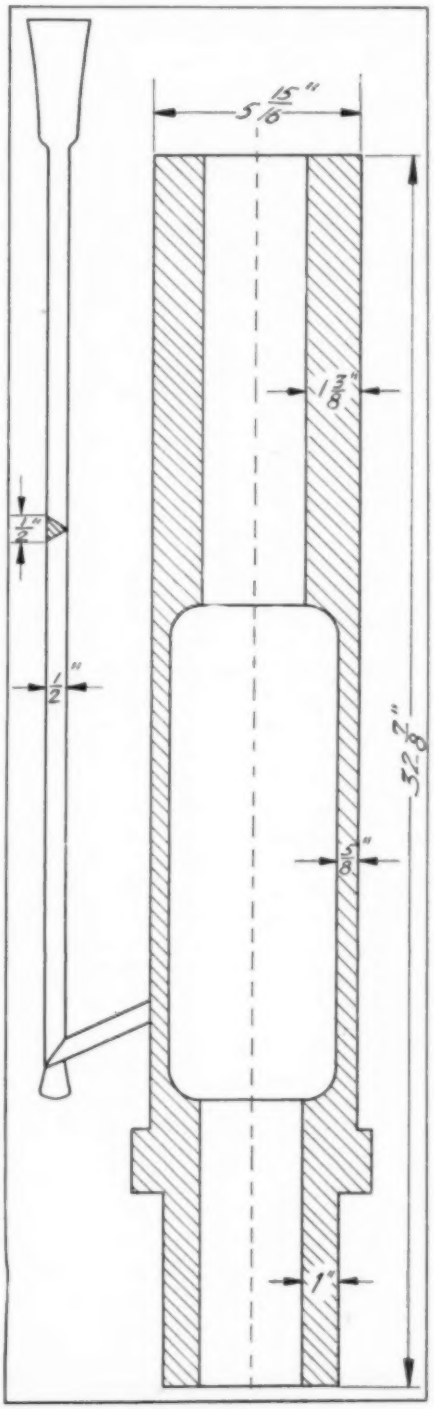


FIG. 13—MOLDING MACHINE COLUMN WEIGHING 117 POUNDS. WEIGHT OF RUNNER 5 POUNDS. SECTION OF TRIANGULAR RUNNER ½-INCH

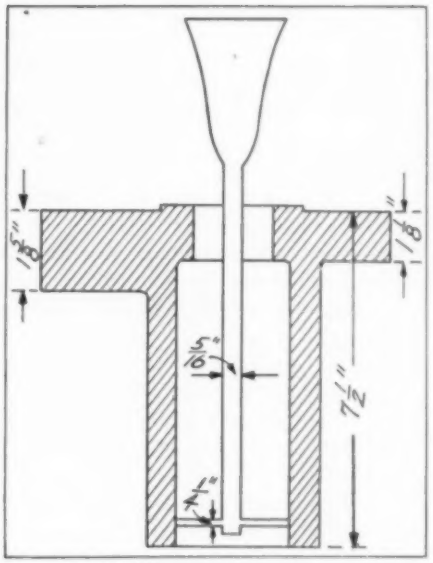


FIG. 14—A VERTICAL RUNNER ⅜-INCH DIAMETER CONNECTED TO TWO HORIZONTAL RUNNERS EACH ¼-INCH DIAMETER SERVED TO RUN THIS CASTING WEIGHING 16 POUNDS

invention; he has no desire to claim that it is his, though in spite of his efforts it often is called "Mr. Ronceray's System."

An investigation of the slow pouring process has disclosed that it is partly used in many shops, though unsystematically. In the Western Railway Works, Mr. Saillot found some castings made by a similar process to that which he had introduced. During the Liege exhibition of the French and Belgian foundry associations, the author discovered in local shops locomotive cylinders and many other castings were made according to the same principles, possibly through some knowledge of what Mr. Saillot did at Gotteville some years before, possibly for some other reasons. Brunelli, years ago, recommended pouring through small runners about pencil size on the top of castings. Consequently there is no invention on the author's part, but only an attempt to collect data and to find explanations for facts which are of the utmost interest to foundrymen.

Samples Noted

With this understanding, perhaps it will be appropriate to present a short description of a few samples of castings which have been made successfully by slow pouring and with no feeding heads. First, the castings described in an original article in *La Fonderie Moderne* shown in Figs. 12, 13 and 14.

Some trouble is experienced from scabbing with the castings shown when proper sand is not used for the core. Similar results are obtained by

Brunelli runners used on top of casting.

The top of the core shown in Fig. 14, being heated inside and outside, is liable to evolve too much gas and produce a waster when the core is not perfectly vented. This casting now is poured on top with a ¼-inch diameter runner.

The author has pointed out the following conditions under which castings can be made without feeding heads: (a) where the nature of the casting is such that the gating and cooling can be arranged so that solidification takes place at the same time throughout the casting; (b) where there will be no swelling of the sand, or, if there is, it will not continue after pouring is completed.

Small runners involve the use of very hot metal. The runners must be kept filled during the pouring so that no air or slag enters the mold. The slag always must be kept out of molds if sound castings are expected. Numerous methods are available to obtain this result, if foundrymen only gave the question consideration.

Belgian Experiments

Confirming the results mentioned in various papers Mr. Leonard says that slow pouring has the additional advantage of giving more time for the gas to escape. He cites interesting examples which are confirmed by the author's practice. He also agrees that when risers are used they must be plugged or covered; otherwise it is not unusual to find them contaminated with blowholes. Belgian friends, especially Mr. Lamoureux, have remarked that their practice differs slightly from the author's sketches in that when they use small runners they manage to have the reduction far from the castings and increase the size of the runner close to it, to reduce the speed of metal entering the mold. This is quite reasonable, especially when the stream is striking a core or a part of sand. It can then cause scabbing and it is advisable to follow this suggestion.

Figs. 1 and 10 refer to locomotive cylinders cast vertically at Cockerill Works, Seraing, near Liege, Belgium. It can be seen that the runner is choked close to the basin and that afterward the size of the runners are increased. Risers are provided to allow some iron to run through. Their section is too small to consider them as feeding heads. This practice is quite common in the Liege district, and the discovery was a source of great satisfaction to the author.

Among other confirmations of satisfactory results from Great Britain the author has received from John Musgrave & Sons, Limited, Bolton, interesting details connected with molding the cast iron shown in Figs. 5, 6 and 7. It is said that previous to adopting this system they were obliged to have a large riser over each of the bosses, also one on the body. This meant four risers to be fed and afterward cut off by machine. The casting made under the new system was broken and found to be absolutely solid and without any signs of sinking on the outside. Another casting made from a semi-steel mixture with 35 per cent steel and with the gates slightly enlarged gave the same good results. Fig. 5 shows the casting after breaking. Another casting made by the same firm is shown in Fig. 3. It is a face-plate coupling, weighing 112 pounds. The diameter of vertical is ½-inch and that of the two horizontal runners ¼-inch. It is said that previously this casting had to be fed to avoid porosity. No sign of sinking was found; broken, it was perfectly solid and even in texture, and the machine-shop foreman claimed it was the cleanest casting he ever had to machine.

While visiting works in Liege and vicinity and noting some interesting castings poured in unusual ways the author was struck at Esperance-Longdoz foundry by the appearance of a heavy roll lying on the floor, on which traces of only a few small, very thin gates were noticeable. The casting weighed about 10 tons and apparently had no feeding head. Moreover, after inquiry, it was ascertained that the part of the casting where the gates were attached had to be cut out, and a satisfactory reply could not be obtained as to why this part was added to the pattern. The author was informed that the idea was to have more pressure on the casting. It was more likely, however, that it was put there more as a safety factor than anything else.

Heavy Weight Poured

The 10 tons of iron were poured through 8 round gates ⅝-inch diameter. Thinking that it would be most interesting to find out whether the head was sound, the author asked the foundry manager, M. Varlet, to split it after having cut it, and to send him a photograph of the section. He was good enough, with the permission of his managing director, M. Stoultz, not only to do this, but also to sacrifice the casting. This casting is shown in Figs. 4 and 9 and undoubtedly a most remarkable job.

M. Saillot's attention, as previously stated, first was called to this subject by an incident during the pouring of a gunmetal casting. It may be of interest, therefore, to conclude this paper by recounting how a brassfounder, M. Fariner, who recently visited our foundry and also who had read the original article, carried out some experiments on castings that previously had given trouble. He used small gates with complete success. The first was a plain cylinder made of 88-10-2 metal 13 inches outside diameter, 6 inches deep and 1¾ inches thick, weighing 77 pounds. It was bottom cast, with two ¾ x ⅛-inch runners. The second was a bearing casting made in 86-12-2 metal and weighed 42 pounds. It was bottom cast by two runners of 19/32 x 3/32-inch. Both castings were in every way satisfactory.

Typical Cases

Many reports of successful experiments have been received from different parts of Europe, but the object of this paper was to mention some typical cases, with names of works, so that the statements might be accepted as authorative. No doubt other foundrymen will succeed in many cases if they try by themselves.

The underlying scientific principles are not dealt with in detail because the author is not certain that his hypotheses are right. Suffice to say for the present that it is possible by this method to pour successfully a great number of castings that formerly have been considered impossible to cast without feeders and to get them sounder than those poured with feeding heads.

Obviously it is desirable that scientists and practical men should try to determine causes for such results, which probably will result in the discovery of unknown laws.

In conclusion, the author desires to thank Mr. Griener, general manager of Cockerill Works; Mr. Droyart, superintendent of the foundries; Mr. Stoultz, managing director; and Mr. Varlet, foundry manager, of Esperance-Longdoz Works, for this kindness in supplying photographs and drawings showing their practice. The author further is indebted to Messrs. John Musgrave & Sons, and Mr. L. A. Bentley, their foundry manager, and Mr. Fariner, for having experimented on the lines indicated, and for giving permission to use the documents they so kindly had prepared.

The Lamson Co. has consolidated its offices and manufacturing division, formerly located in Boston and Lowell, Mass., respectively, with its new plant located at Syracuse, N. Y.

Correcting Flaws in Metal Mixtures

Problems of the Gray Iron, Malleable and Steel Foundry Discussed

By H. E. Diller

Slow Melting Due to Low Blast Pressure

Question—We have a cupola lined to a 44-inch diameter. The sand bottom is approximately 6 inches deep at the back, tapering to 5 inches at the spout. The tuyeres are 5½ x 8½ inches. From the top of tuyere to the bottom of the charging door is 12 feet. The blower delivers approximately 4200 cubic feet of air per minute against a pressure of approximately 6½ ounces. Twelve hundred pounds of coke are added on the bed and 180 pounds are used between charges of 1600 pounds of which 650 pounds is scrap iron and the remainder pig iron. We have tried various ways of charging the cupola, but have always aimed to keep iron about 30 inches above the tuyeres. The best we can do is to melt 4½ tons in 50 minutes, using a coke ratio of approximately 4 1/5 to 1. We think we ought to melt approximately 8 tons per hour, and want to lower the coke ratio.

Answer—From the information you give we see little that is wrong with your cupola or melting practice except that the blast pressure is too low. However, you do not state how long the fire is in the cupola before you put on the blast. You should light the kindling in the cupola at least two hours before the blast is on. This warms and dries the bottom and walls of the cupola, and gives you better iron and quicker melting at the start. It is difficult to understand how you can get the volume of air which you say you get using 6½ ounces pressure as usually this pressure would not force through the cupola such a volume of air. You should check your figures by the use of a blast gage on the feed pipe. You would get more rapid melting by increasing the air pressure to approximately 12 ounces. You say you are getting a melting ratio of approximately 4½ to 1. This includes the bed which cannot rightfully be included in the melting ratio. The reason for this is that if you melt only two charges your melting ratio would be much higher calculating the bed of the cupola than if you melt 100 charges. However, the coke on each charge shows a ratio of approximately 9 to 1 which is satisfactory.

You do not say whether you figure the melting time from the time the blast is on or from the time the first iron melts. You should melt at the rate of from 7 to 9 tons an hour, calculating from the time the first metal comes from the cupola. You might reduce your coke by lowering the amount put on the bed if iron does not come from the spout ten minutes after the blast is on. Increase in blast pressure would also increase the melting rate.

Shrinkage in Iron

Question—We make sewing-machine castings and find that the iron has high shrinkage. The following is the calculated and the actual composition of one heat in which 5 per cent of steel was used.

Composition	Calculated	Actual
Silicon	3.26	3.42
Sulphur	0.097	0.102
Phosphorus	0.573	0.592
Manganese	0.68	0.68
Total carbon		3.02

Answer—The silicon in your finished castings should be around 2.50 to 2.75 per cent. The amount of total carbon which you report is unusually low for cast iron melted in the cupola with only 5 per cent steel in the mixture, and is probably the chief cause of the excessive shrinkage. It may be due to the pig iron having an abnormally low percentage of total carbon or to oxidation in the cupola, both of which are undesirable. The carbon in your iron should be close to 3.25 per cent instead of around 3.00 per cent as you report.

Melting Temperatures of Cupola Iron

Question—Please tell us what temperature is required to melt iron in the cupola.

Answer—Iron melts at different temperatures depending upon the amount of combined carbon contained in it. A white iron will melt as low as 2000 degrees Fahr., while an iron with only traces of combined carbon will require nearly 2300 degrees Fahr. for melting. In the cupola the iron after being melted is superheated, passing through the hot zone of coke and will come from the furnace at 2300 to 2400 degrees Fahr.

Finds Machining Trouble

Question—One of our customers who wants castings of a strong, soft iron which will take a good finish and can be machined rapidly, complains that the castings we are furnishing him do not cut as they should. These castings weigh from 5 to 1000 pounds. We use a mixture consisting of half pig iron, 3.0 per cent silicon, and half machinery scrap such as looms and parts free from wrought iron and steel.

Answer—We would know better how to advise you if we had the thickness of sectons of your castings and what the specific trouble is in machining. An analysis of some castings on which complaint is made would also be of assistance in locating the trouble. From what you state we judge that the iron is possibly coarse grained, and would suggest that you use 10 to 15 per cent of steel scrap in place of pig iron in your mixture. The steel scrap should be added immediately after the coke and the pig iron put on top of it, adding the iron scrap last. This would close the grain of the metal, but with the mixture you are using would not harden it appreciably. The casting therefore would give a finer finish and could be worked at a fairly high speed.

Breast Jacket Casting

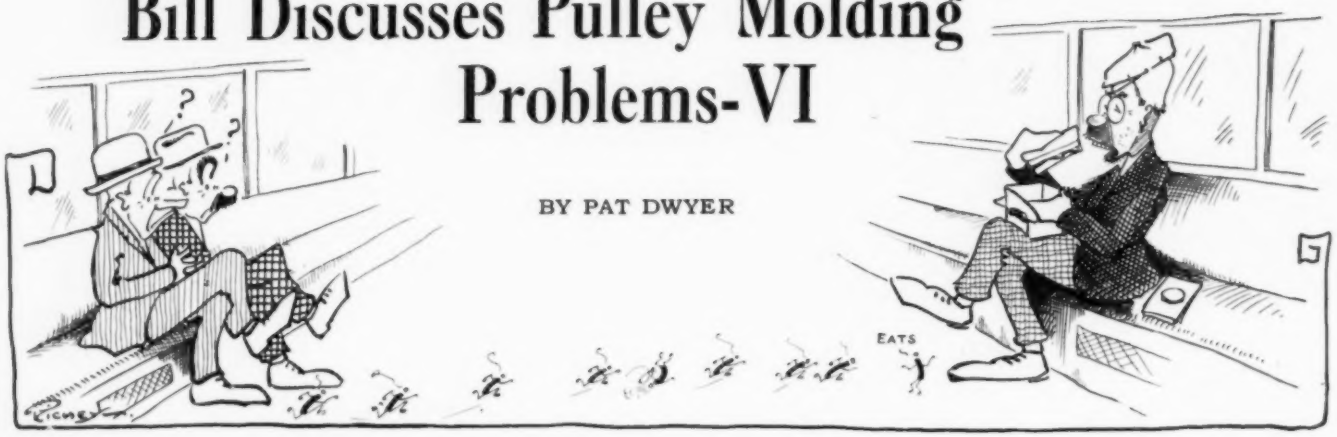
Question—Will you kindly name the brand of pig iron suitable for making cast-iron breast jackets for a lead furnace, and also indicate its composition. The castings must withstand a great heat.

Answer—For the casting of which you inquired you should have an iron of the following analysis: Silicon, 1.5 to 1.75 per cent; sulphur less than 0.12 per cent; phosphorus 0.2 to 0.4 per cent; manganese 0.5 to 0.7 per cent.

The element which it is most important to get within these limits is the silicon, and the other elements can be varied somewhat, if necessary. You should get a pig iron with approximately 2.25 per cent silicon; below 0.5 per cent sulphur; 0.2 to 0.4 per cent phosphorus; 0.7 to 0.9 per cent manganese. The mixture, if cupola iron is used, should be made up of approximately 35 per cent of your own scrap iron; 10 to 15 per cent steel scrap and the remainder pig iron.

Bill Discusses Pulley Molding Problems-VI

BY PAT DWYER



DID you ever sit in a street car and attempt to classify your fellow passengers by their outward appearance? Not necessarily to make a complete card-catalog index classification, after the manner of the late Sherlock Holmes, or our own gifted artist in the general line—need I say that I refer to Mr. Carter of happy memory—but just a general sizing up; what I believe is known in the vernacular as giving them the once over? The performance is only mildly interesting if you are alone, but it presents many pleasant features if you happen to sit with a congenial spirit and thus are in a position to check up on your observations. It may be claimed that this is at best a vulgar form of amusement and that a person might be much better employed than in commenting on the appearance of one's neighbors, but there is an old saying to the effect that what a person does not know never will hurt him. So long as the person under observation is not aware of the fact, no harm is done. Besides, in all probability, other passengers have you pasted on the slides of their mental microscopes with a view to hanging you on the proper hook. This consoling thought at least gives you an even break and compensates in great measure for twinges of any remaining conscience you may possess, relics as it were from your early days when you were taught what was what along this line.

Usually Bill and I spend the time of our morning ride down town in glancing through the morning paper. Bill devotes nearly all his attention to the sporting pages and dismisses briefly, with a fleeting look at the head lines, all the important events chronicled on the first page. The fact that Madalayne's chow dog recently had its hair bobbed, or that Muriello had discovered a historic document proving conclusively that one of her ancestors, on her mother's side had been a lady-in-waiting to Queen Elizabeth, or the Queen of Sheba, or perhaps the Queen of clubs, bounces off his mind as readily as hail off a tin roof. Occasionally he is fooled by a head line that might mean anything.

He keeps in fairly close touch with the activities of the race track and in addition is familiar with the names of all those sterling young athletes who go about the country after the manner of their famous knightly prototypes seeking advancement through the medium of hard knocks—at so much per knock. However, his principal interest centers around the exponents of the great national game and the manner in which he can quote statistics covering the batting average of each player and the relative standing of each team in the league is nothing short of marvelous. This is only his city by adoption, but to hear him talking about the local team you would imagine that in some mysterious manner he had a proprietary interest in it and that if the team came within pennant winning distance, it was a matter for congratulation all around.

The other morning, for some reason, our paper boy was not at his accustomed position and we had to board the car without a paper and as a result we had nothing definite to engage our attention all the way down town. There is a rhyme somewhere about Satan finding work for idle hands. I don't know whether or not Satan should be given all the credit. Opinions differ on that point and I am not one violently to uphold partizan views on a subject in which I am not particularly interested; but whoever, or whatever agency is responsible, should also be given credit for finding employment for idle eyes and tongues. We only had been sitting quietly for a few minutes when Bill directed my attention to a man sitting on the opposite side of the car. His face and figure were familiar from the fact that he usually rides down in the same car every morning. He carried a lunch box, was dressed in a plain suit in which the coat did not match the pants, wore a cap pulled well forward, a pair of glasses, and a faded neck tie under the turn down collar of an old blue shirt. His hair and huge moustache, sprinkled with gray, would seem to indicate that he was somewhere between 40 and 50 and the fact that he had not shaved for at least two days led me to believe that he worked at some job where personal appearance was not a serious factor.

HE WAS FAR FROM BEING A CLAM

"Ladies and gentlemen," said Bill to me, confidentially, "let us consider for a moment the interesting specimen of humanity who has so considerately—if not unconsciously—consented to an examination to determine his position as a member of our community. He takes the same car every morning, therefore he is a man of orderly habits and probably has worked for the same firm for many years, one of those faithful

PHYSICAL PROPERTIES OF ALUMINUM

By W. Rosenhain

Chill-cast bars, 1-inch diameter:

Yield Point	Ultimate Strength	Elongation
5150 pounds per sq. in.	11,700 pounds per sq. in.	37.0 per cent in 2 in.

Sand-cast bars; 1-inch diameter:

Yield Point	Ultimate Strength	Elongation
5600 pounds per sq. in.	11,000 pounds per sq. in.	24.0 per cent in 2 in.

Rolled rod; 13/16-inch diameter:

Yield Point	Ultimate Strength	Elongation
14,600 pounds per sq. in.	16,100 pounds per sq. in.	30.5 per cent in 2 in.

Sheet aluminum; hard rolled:

Yield Point	Ultimate Strength	Elongation
20,100 pounds per sq. in.	22,400 pounds per sq. in.	5 to 6 per cent in 2 in.

Sheet aluminum; 14 gage, soft:

Yield Point	Ultimate Strength	Elongation
3600 pounds per sq. in.	14,600 pounds per sq. in.	5.5 per cent in 2 in.

Drawn aluminum rod; 13/16-inch diameter:

Yield Point	Ultimate Strength	Elongation
19,000 pounds per sq. in.	19,500 pounds per sq. in.	19.5 per cent in 2 in.

The strength of rolled mild steel and rolled brass are given to serve as a basis of comparison as follows:

Strength of rolled mild steel:

Yield Point	Ultimate Strength	Elongation
36,000 pounds per sq. in.	67,000 pounds per sq. in.	41.0 per cent in 2 in.

Strength of rolled brass:

Yield Point	Ultimate Strength	Elongation
48,000 pounds per sq. in.	56,000 pounds per sq. in.	35.0 per cent in 2 in.

From a lecture delivered before the Royal Society of Arts, April, 1920.

PROPERTIES OF ALLOYS OF COPPER AND ZINC

By Leon Guillet

Alloy: Copper, 60 per cent; zinc, 40 per cent.
Analysis: Copper, 60.15 per cent; zinc, 39.84 per cent; tin, nil; iron and lead, traces.

Tensile Test					Impact Test	
Ultimate strength, lbs. per sq. in.	Elastic limit, lbs. per sq. in.	Elongation per cent in 2 in.	Contraction	Resilience	Angle, deg.	Hardness
Condition of sample, rolled:						
54,000	17,100	48.0	51.7	14.3	...	93
Annealed at 800 degrees Cent.:						
52,000	14,600	50.0	62.2	17.5	110	78
Quenched in water from 600 degrees Cent.:						
51,500	.....	36.0	52.7	13.3	139	92
Quenched in water from 800 degrees Cent.:						
53,000	33,100	8.0	11.5	7.8	153	145

Alloy: 60-40 copper with tin.

Analysis: Copper, 60.25 per cent; zinc, 39.23 per cent; tin, 0.52 per cent.

Tensile Test					Impact Test	
Ultimate strength, lbs. per sq. in.	Elastic limit, lbs. per sq. in.	Elongation per cent in 2 in.	Contraction	Resilience	Angle, deg.	Hardness
Condition of sample: As cast:						
48,000	14,600	42.0	38.9	11.25	133	82
Rolled:						
54,500	18,900	52.0	63.0	11.25	137	87
Drawn:						
62,600	49,200	31.0	63.0	12.2	142	127
Annealed:						
54,500	17,100	50.0	62.2	20.0	Bent	92

From an article in *Revue de Metallurgie*, July, 1921, pp. 445-58.

Note—This sheet may be cut into two sections 5x7 inches, and may be readily bound in note book form.

THE FOUNDRY DATA SHEET, October 15, 1922
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

retainers who put their masters' interests above their own. His hands are fairly clean which would not be the case if he worked in a foundry or any of the allied iron working industries. I think you will find that he is an assistant foreman in a sash and door factory. This conclusion is further strengthened by the dominating nose and ferocious moustache. I should set him down as the foreman if it were not for the fact that he wears no white, or near white collar and also he lacks a diamond ring on the fourth or cigar-flickering, finger of the left hand. You will notice that he keeps his eyes straight ahead and takes no interest in the street sights through which he passes. To my mind that is conclusive evidence that he was born and lived all his life in this town. If he was a stranger or an alien he would look out occasionally, even if it was only to verify his position. You could blind fold that bird, lead him to the car in the morning and he would get off at the right stop without removing the bandage from his eyes, without paying any attention to the conductor's translation of the street names and without asking any of his fellow passengers a question."

"Perhaps you are right," I said, "I have been mistaken so often in my first impression of people that I should hesitate to offer an opinion. However, I don't mind telling you that he looks to me like an ex-bartender and I should not be at all surprised to learn that he now is simply marking time as a school janitor or a baggage man at the station, while waiting for the 18th amendment to the Constitution to be repealed. Anyway, what do I care? Neither one of us knows the man, and probably never will come to know him and therefore what's the use of speculating on the subject. If he was not so grouchy looking I should engage him in conversation and have the pleasure of proving that you are mistaken on every count."

Bill admitted that he was not particularly interested in the man's antecedents, present or future status; but since I had seen fit to question the inferences he had drawn from the man's outward appearance, he was minded to submit the question to a fair and impartial test. He proposed that we go over and sit down with the stranger and, as he said, "throw a few leading questions into him." I was not enthusiastic over the idea, partly because I felt it was going too far and partly because the man did not look like a person who was fond of talking. However, we shifted seats and Bill fired the opening gun by remarking that we were strangers in the city and would feel indebted if our friend would direct us how to find the city hall where we had a little business to transact with the mayor.

You should have seen our new friend brighten up. Instead of a clam appeal to him. At the present time he was a kind of a chamber maid in a bird store where they sold canaries, chickens, household pets of various kinds, and seeds. He did not care much for the job or the pay and probably would quit in a short time. When we finally broke away he was still going strong. We had no time

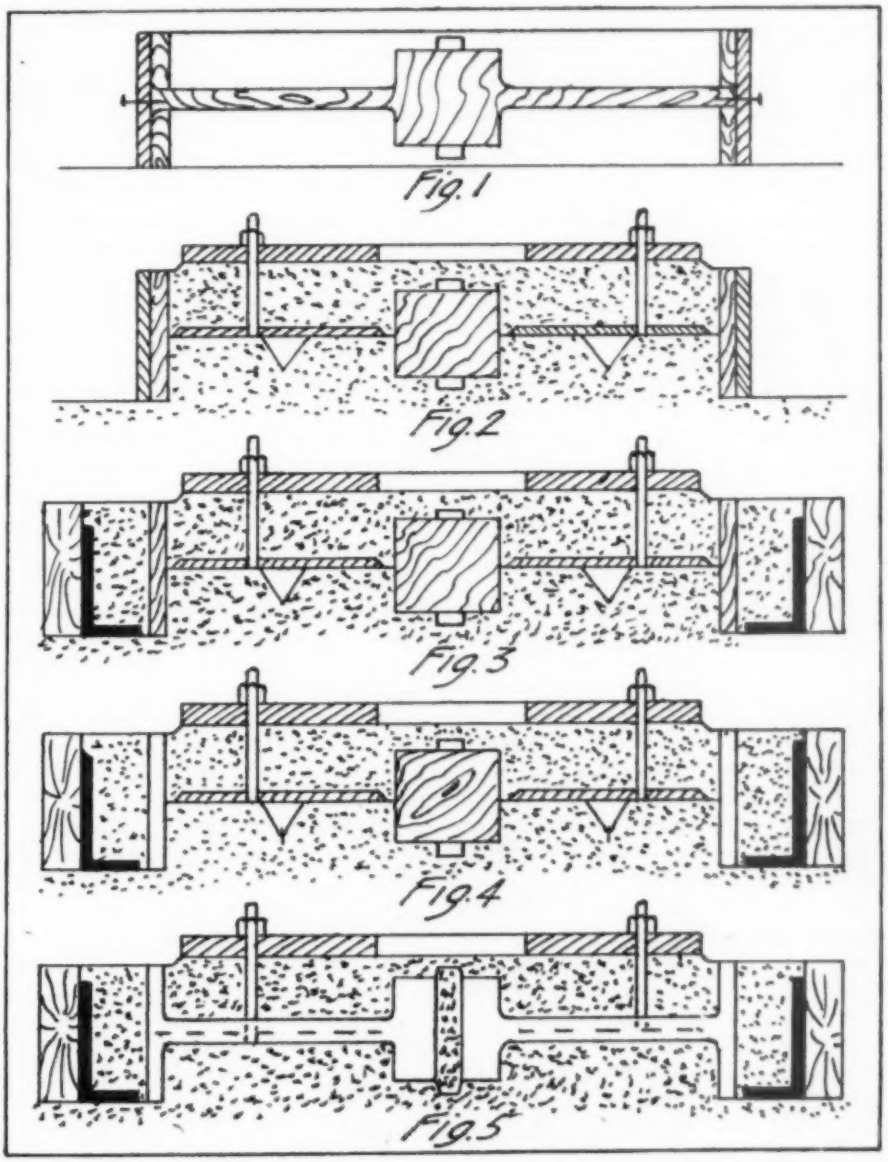


FIG. 1—PATTERN WITH LAGGING IN PLACE FIG. 2—LIFTING AND COVER PLATE ATTACHED FIG. 3—PATTERN REMOVED AND CHEEK RAMMED FIG. 4—LAGGING REMOVED—INSIDE AND OUTSIDE READY TO BE LIFTED FIG. 5—RE-ASSEMBLED MOLD

—to use Bill's expression—we found that he was one of those garrulous individuals who—to again quote Bill's post mortem statement—"spills all he has to every person he meets." He only had lived in the city a few months and before that had spent all his life in a small down state town where he had worked as a general utility man at all kinds of odd jobs. He had a chance to go into a planing mill at one time, but the work did not to discuss the subject after leaving the car, but on the way home again that night I met Bill and suggested that he select one of our fellow passengers for analysis.

"Well," said he, "I'll tell you. The best of us make mistakes some times, but I am willing to admit that the cuckoo this morning certainly was a prize package. There was something familiar about the name of the little town he mentioned, but it was not

until this afternoon that the connection registered. Many years ago in an Eastern foundry I knew a man who hailed originally from the same place. I don't know where he learned the trade, but he most assuredly was a skillful lad with the tools and turned out some beautiful castings. He was an old man when I knew him, or at least he appeared old to me at that time, although I suppose, looking back at it now he was not over fifty. Age after all is only relative and when a person is at least twice your age he is considered old. I was doubled up with him occasionally and had an opportunity to handle jobs that otherwise would not have been entrusted to a young fellow. He was equally familiar with green sand, dry sand or loam and was one of the comparatively few really good all around molders it has been my pleasure to know. Whenever an order was received for any job out of the ordinary, old Jack usually was selected to make it. He preferred to work alone and in justice to all concerned it must be admitted that none of the boys or young men showed any desire to cross his wishes in that respect. Not a man ever was heard to give three rousing cheers when notified to assist the old fellow and I have known of instances where some of these sterling young athletes deliberately remained away from the shop for a day after they had been notified on the preceding day that they were expected to double up with our hero on the morrow. He was a man of few words with a frankly expressed contempt for what he called *wind bags* and in addition he had supreme confidence in his own ability and an autocratic aversion to interference, suggestion, or what he considered, idle questions from any person sent to assist him.

"Fortunately I was young in those days and obedient in the presence of my elders and what may seem more remarkable, I had sense enough to know that I was being given an opportunity of associating with a master hand. I kept my mouth shut, my eyes and ears wide open and did exactly as I was told—no more, no less—and as a consequence we got along famously. In fact in a short time I discovered that instead of being a grouch, as I had been led to believe, the old boy was an exceedingly likable character in a somewhat reserved manner. When he had satisfied himself that I really was a deciple earnestly seeking the light, he thawed out wonderfully and seemed to take a certain amount of pleasure in communicating some of the inner and finer points of the game. In later years, when I in turn occasionally assumed the role of teacher, I learned to appreciate the difference between a young man with an open and receptive mind and one of those half baked young dumb bells, who think that the manner in which they spend the night is the only object of their earthly existence. However, what I had in mind in talking about this man was that he was the first molder I ever saw making a pulley several inches smaller in diameter than the pattern.

"The causes leading up to the customer insisting on having a pulley of this particular diameter were interesting, as I learned afterward, but as that information has no direct bearing on the point at issue, as our legal friends say, we shall not enter it upon the record. The only feature that really matters is that the only pattern we had near the size, was 2 inches too large in diameter. To my mind the cheapest and best way to have made the mold casting would have been to sweep it up and form the arms in dry sand cores. However, my opinion was not asked and besides it is quite probable that some good and sufficient reason, of which I was not aware, influenced the old man to choose the method he did. The only patternmaking expense attached to the job was that involved in preparing a sufficient number of lagging strips 12 inches in length by 1 inch square, to go around the interior face of the pulley pattern rim.

"The pulley pattern consisting of the usual iron rim and set of wood arms, held temporarily in place by spikes inserted through holes in the rim, was leveled on the floor and sand was rammed inside the rim and under the arms. A parting was made in the usual manner and a lifting crab set in between the arms. The remainder of the space above the arms and inside the rim was rammed full of sand and then the covering plate was bedded down and the bolts attached to the crab were screwed up tight. The rim pattern was rapped all around with a wooden mallet and after the spikes holding the arms had been removed, the rim was drawn, leaving the arms in place in the center of the mold and the lagging in place surrounding the body of sand forming the interior of the mold. A single strand of wire was bound around the lagging circle near the top to prevent any of the pieces that showed a tendency that way, from falling down. This wire was removed later after a sufficient quantity of sand was rammed in the cheek to hold the lagging in place.

"A flat parting was made all around the outside at the bottom of the lagging strips and on this surface a wooden cheek provided with corner pieces and chucks was placed. Gaggers were set all around with their toes pointing toward the pattern and then the cheek was filled with sand and rammed to the top where the sand was struck off flush with the top of the lagging strips. The strips were drawn one at a time, with a pair of pincers instead of the wood screws usually employed. The speed with which they were pulled more than compensating for the time afterward employed in patching the cavities left around the top of the rim by the nose of the pincers. The crane was hooked onto the covering plate and the body of sand above the arms was lifted out and set down while the remainder of the mold was being finished. The cheek was lifted off and the face of the mold slicked and after the arms had been blacked and the center core set, the mold was reassembled and poured.

"The method outlined is only an

YOU PROBABLY HAVE NOTICED THAT THE SCREEN VERSION ALWAYS IMPROVES ON THE ORIGINAL

emergency measure, but it may be applied in whole, or in an adapted form to many problems of the same general character. I have used it since that time in making a pulley from an old casting in which, of course, the rim and arms were a unit. That job involved lifting the body of sand above the arms, twice; but in a general manner the process was the same as here-in outlined. Taking them all in all pulleys present some interesting problems."

I ventured the opinion that a man who could read his fellow passengers at a glance should not experience any trouble in solving any problem liable to arise in the foundry. Keen observation is all that is required.

"You talk like an outsider," said Bill. "Problems arise in the foundry every day that would tax the combined mental resources of Solomon, the Angel Gabriel and the Three Wise Men from the East. You seem to have forgotten the connection between the term 'Cat' as applied to a molder and the famous old sentimental ballad 'What makes the wild cat wild, boys, Oh! What makes the wild cat wild?' "

Determine Sulphur by Evolution Method

BY V. E. HILLMAN

THE evolution method for determining sulphur in iron and steel has its own particular sphere of usefulness, even though it yields values which are a trifle lower than those obtained by the more tedious gravimetric procedure. However, there will be no occasion for dispute if the analyst will embody the caption, *Evolution Sulphur* in his report.

Plain carbon steels generally yield concordant results which are dependable for routine work. The products of the blast furnace and cupola give percentages which are reliable for guide purposes, although duplicate analyses do not always give values which are in close agreement. This may be due in a measure to segregation in the metal, or to causes which are beyond the immediate control of the analyst. In any event, the evolution method has found a permanent place in the laboratory inasmuch as it is indispensable in the routine analysis of iron and steel products.

The sulphur in ferrous metals exists either as manganese sulphide or as iron sulphide, generally as the former if the metal contains its proper allotment of manganese. The sample drillings are treated with hydrochloric acid and an evolution of hydrogen sulphide ensues:

$$MnS+2HCl=MnCl_2+H_2S$$

The gas is converted to a metallic sulphide by conducting it through a suitable absorbent:

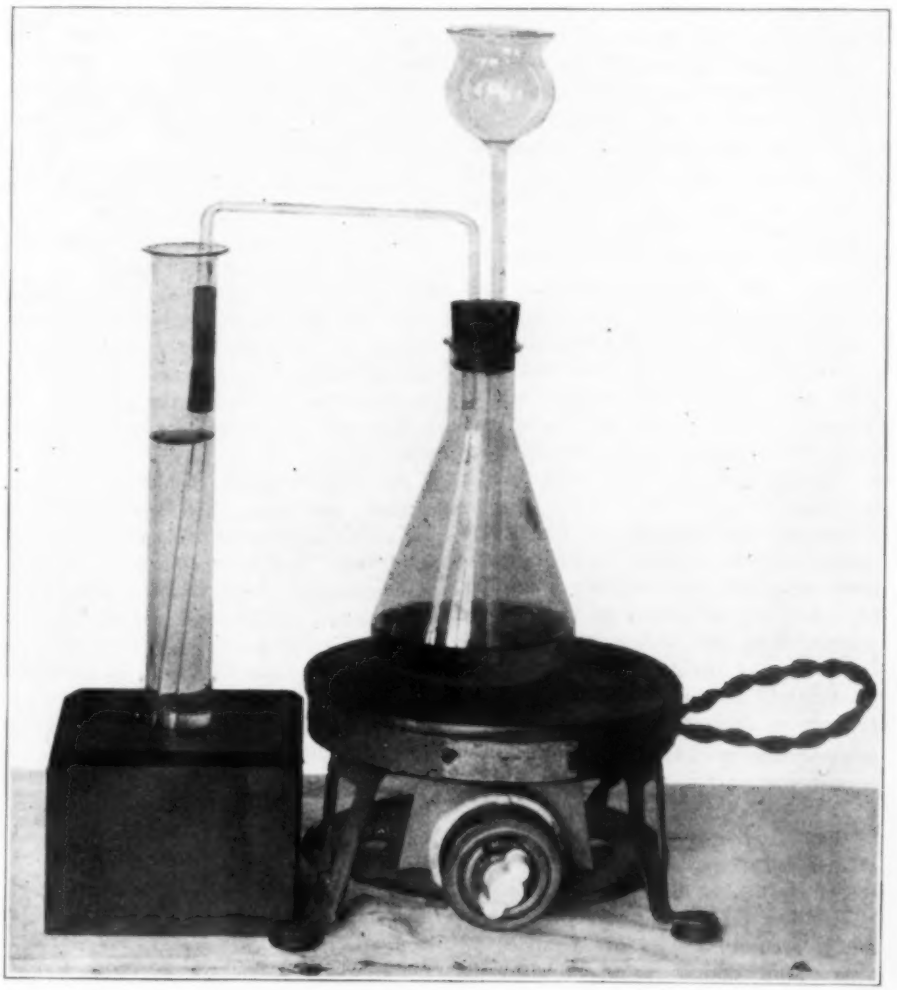
$$H_2S+2NaOH=Na_2S+2H_2O$$

The sulphide is subsequently dissolved by the aid of hydrochloric acid which again releases the hydrogen sulphide in a suitable vehicle for titration. The hydrogen sulphide is titrated with a standard solution of iodine, in accordance with the following reaction:

$$H_2S+2I=2HI+S$$

In routine analysis, evolution sulphur determinations are operated in any convenient number, usually in multiples of two or three depending upon the size of the laboratory. The accompanying illustrates a form of equipment which is robust, compact and easy to manipulate.

Three grams of drillings are weighed, and introduced into a dry 300 cubic centimeter erlenmeyer flask. A tight fitting rubber stopper equipped with a thistle tube and an exit tube is inserted into the mouth of the flask. The generator is placed on the stove, coincident with the immersion of three-quarters of the delivery tube into 90 cubic centimeters of absorption solution. Seventy-five cubic centimeters of hydrochloric acid (2 parts of acid to 1 part of water) are poured into the receiving bulb of the thistle tube. The lower end of it should extend beneath the surface of the acid in the flask during the process of evolution. Occasionally, concentrated acid is used when the metal fails to respond effectively to an acid of lesser strength. However, the use of concentrated acid, causes a copious froth to form in the generator thereby rendering it more difficult to determine when the solution of the sample is



APPARATUS FOR DETERMINING SULPHUR BY THE EVOLUTION METHOD

The author, V. E. Hillman, is metallurgist, Crompton & Knowles Loom Works, Worcester, Mass.

complete. When the acid comes in contact with the drillings, an evolution of hydrogen and hydrogen sulphide ensues. The hydrogen goes free while the hydrogen sulphide is entrapped by the absorbent. The acid vapors which pass through the delivery tube and come in contact with the ammoniacal absorbent give rise to ammonium chloride fumes. These are of no consequence, and should be disregarded.

After the first action of the acid has subsided, apply heat until the solution simmers. The steam which is generated expels the last trace of hydrogen sulphide from the evolution flask. Prolonged boiling of the solvent is to be avoided, as excess acid vapors destroy the alkalinity of the absorbent. Remove the apparatus from the hot plate, and wash off the small amount of absorption solution which adheres to the delivery tube. Pour the contents of the test tube into a tumbler, rinse once, and add a piece of litmus paper. If the solution gives an acid reaction, the analysis should be discarded and another determination started. To the alkaline solution in the titrating vessel, add a slight excess of hydrochloric acid (one part of acid to one part of water) and accompany this action by gentle stirring with a glass rod until the indicator turns red. Avoid an acid layer. However, careless agitation of the solution contributes to low results.

Titrate the acidified solution with standard iodine until a faint blue color is discernible. The solutions obtained from bessemer steel, cast iron, and malleable iron manifest an orange coloration prior to the appearance of the end point. Plain carbon steel determinations pass directly from the water white to the blue color.

Knowing the strength of the iodine solution and the number of cubic centimeters of iodine required to produce the end point, the calculation of the sulphur percentage in the unknown sample is determined by inserting the necessary values in the equation:

$$\text{per cent of sulphur in sample} = \frac{\text{cubic centimeters of iodine} \times \text{factor}}{\text{Weight of steel sample}} \times 100$$

Soluble starch is used as an indicator to determine the end point. Some laboratories add the indicator to the solution just prior to titration. However, equally accurate results are obtained by mixing the starch solution with the absorbent at the time the latter is made.

To make the solution stir 12 grams of Lintner's soluble starch and 50 cubic centimeters of cold water into a smooth emulsion. Starch prepared accordingly to Lintner differs from the ordinary starch in that it is purified potato starch and specially treated, whereby it is rendered soluble and loses the property of gelatinizing. Add the starch paste to 1950 cubic centimeters of hot water and boil for a few minutes. The indicator should be free from flocks of insoluble starch.

Various absorbents are used for entrapping the liberated hydrogen sulphide. None of them possess any distinct advantage over the others save from the standpoint of cost and availability. The different absorbent formulae are given in the order in which they are used most extensively.

Caustic Alkali Absorbent

Caustic soda	200 grams
Strong ammonia	1000 c. c.
Water	13,000 c. c.
Starch indicator	2000 c. c.

Zinc Sulphate Absorbent

Zinc sulphate	40 grams
Strong ammonia	2500 c. c.
Water	13,500 c. c.
Starch indicator	2000 c. c.

Cadmium Chloride Absorbent

Cadmium chloride	20 grams
Strong ammonia	2500 c. c.
Water	13,500 c. c.
Starch indicator	2000 c. c.

The absorbent and indicator should be compounded independently, and then mixed together.

To make the iodine solution dissolve 20 grams of potassium iodide in 50 cubic centimeters of water. Then add 9 grams of resublimed iodine. The presence of the potassium iodide facilitates the solution of the iodine crystals. When the reagents are completely dissolved, dilute the concentrated solution to two liters. Avoid the presence of iodine flakes in the solution prior to dilution.

An iodine solution should be stored in a dark, cool place. It is susceptible to deterioration even when kept under ideal conditions and consequently frequent standardization is advisable. The solution should be allowed to age several days before it is used for titrating purposes. An iodine solution standardized immediately after it is compounded, gives a radically different factor 24 hours later. In a properly prepared solution, the factor decreases only slightly from time to time.

Standardization of Iodine

Two general methods are in vogue for standardizing an iodine solution. One consists in obtaining a factor from a steel whose sulphur content has been accurately established by gravimetric methods, and the other by titrating against arsenious acid, and calculating the sulphur equivalent.

Standard steel samples containing known percentages of sulphur, can be purchased from the U. S. bureau of standards, Washington, D. C.

A known quantity of the standard sample is subjected to the operations incident to an evolution sulphur determination. The calculation of the iodine factor is dependent upon the weight of the sample, and the number of cubic centimeters of iodine used.

The principle of standardization by the arsenious acid method depends upon the conversion of arsenious to arsenic acid. This is accomplished by adding iodine to a solution of arsenious acid to which free alkali has been added.

$$AS_2O3 + 2I_2 + 2Na_2O = AS_2O_5 + 4NaI$$

Dissolve 0.03 gram of arsenious acid accurately weighed and approximately 0.5 gram of sodium carbonate in 50 cubic centimeters of water. Boiling promotes the solubility of the dendritic flakes which float on the surface of the liquid.

Cool the solution to the temperature of tap water and add 2 cubic centimeters of freshly prepared starch indicator. Moisten 0.1 gram of soluble starch with a few cubic centimeters of water. Dilute the paste to 20 cubic centimeters, boil, cool, and use as directed. If an attempt be made to titrate the hot solution the indicator is rendered inoperative.

Titrate with iodine until the solution is colored a faint blue, which indicates that all of the arsenious acid has been oxidized to arsenic acid.

Two molecules of sulphur are equivalent to one of arsenious acid.

$$\frac{2S}{AS_2O_3} = 0.3239$$

Therefore, the sulphur equivalent of one cubic centimeter of iodine is obtained by solving the following equation.

$$\text{One c. c. of iodine} = \frac{\text{Weight of arsenious acid used}}{\text{Number of c. c. of iodine used}} \times 0.3239$$

Add to Stove Plant

Plans have been drawn for an addition to the plant of the Birmingham Stove & Range Co., Birmingham, Ala., which will add 50 men to the roll and will provide for the manufacture of gas stoves and ranges in the Birmingham district. This company is melting 12 tons of iron daily. B. H. Hartsfield is vice president and general manager.

Offers Foundry Course

The Wentworth institute, Huntington Ave. and Ruggles street, Boston, is seeking to interest foundrymen in the courses offered in patternmaking, foundry practice and foundry management and operation. Recently letters were addressed to foundry executives asking them to recommend young men to undertake a training course in foundry management. E. A. Johnson is head of the foundry department.

Study Core Oven Heat Loss--I

Extensive Tests Made on Two Electrically Heated and One Oil Fired Core Oven—Results Analyzed To Determine Efficiency of the Ovens and Relative Heating Costs

BY C. F. MAYER

THE question often arises, when core or mold drying ovens are discussed, as to what type of oven will perform its duties in meeting certain conditions most satisfactorily and most economically. To meet these queries intelligently considerable study and first hand observations are essential, the results of which are valuable only insofar as they represent fundamental principles rather than a host of data.

However, a volume of data of any sort, tending to illuminate the design or operation of oven equipment, has always been conspicuously absent, although a comparatively small number of tests have been carried on. Most of these investigations seem to have been made with electric oven equipment. Great emphasis was always laid on the amount of material baked, and little stress given to the reasons for attaining the results.

The appearance of the electric ovens, as a comparatively recent innovation to foundry and core room practice, has done a great deal to agitate investigation, and in consequence the more familiar oven equipments are also certain to receive more consideration.

It was our good fortune to have available, under actual working conditions, two electric ovens, of different manufacture and one oil fuel oven. Owing to their similarity in size and production requirements these ovens presented excellent material for investigation. The data and opinions offered are taken from investigations covering a period of more than a year.

We have been inclined to use a hit or miss theory in guessing oven capacity—either through ignorance or careless indifference. This is a most important and frequently costly source of error. Reverting to fundamentals, we are aware that during the process of heating the heat absorbed by the object is dependent on the weight W, specific heat C and temperature rise (t_2-t_1), or formulatively,

$$Q=W\times C\times(t_2-t_1)$$

Likewise we know that the aggregate wall losses vary as the surface exposed A, the coefficient of heat transmission U and the temperature difference (t_2-t_1), for a given time

$$K=A\times U\times(t_2-t_1)$$

The total heating H^T of an oven, then, is the summation Σ of the heat absorption and transmission losses.

$$H^T=\Sigma\ (Q+K)$$

Where $Q=\Sigma$ of heat absorbed by objects heated

$K=\Sigma$ of heat losses (wall losses)

The quantity Q may be divided into four distinct groups, namely, heating the material baked, heating the conveyance (or shelves), heating the air, and heating the walls and oven equipment.

The last item may be classed as initial or permanent absorption*. This heat is finally given up as radiation loss. The transmission losses, K, may be considered as the total losses through the walls and floor (other indeterminable leakage also must be included here).

Paper presented at the recent meeting of the American Foundrymen's association at Rochester, N. Y. The author is connected with the Ohio Body & Blower Co., Cleveland.

*Permanent absorption refers here to heat absorbed and maintained until discontinuation of the day's test.

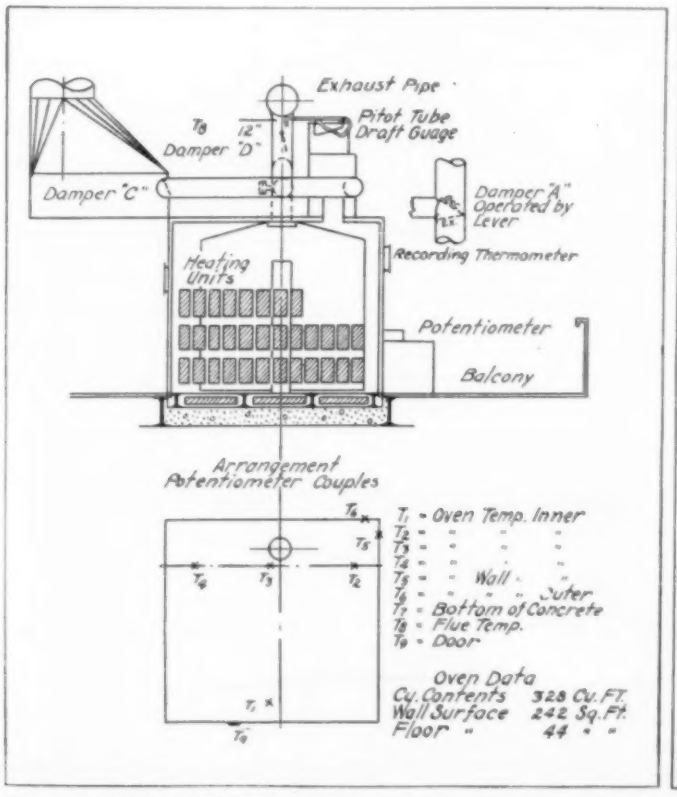


FIG. 1—ARRANGEMENT OF OVEN, *A*, EMPLOYING ELECTRIC HEAT

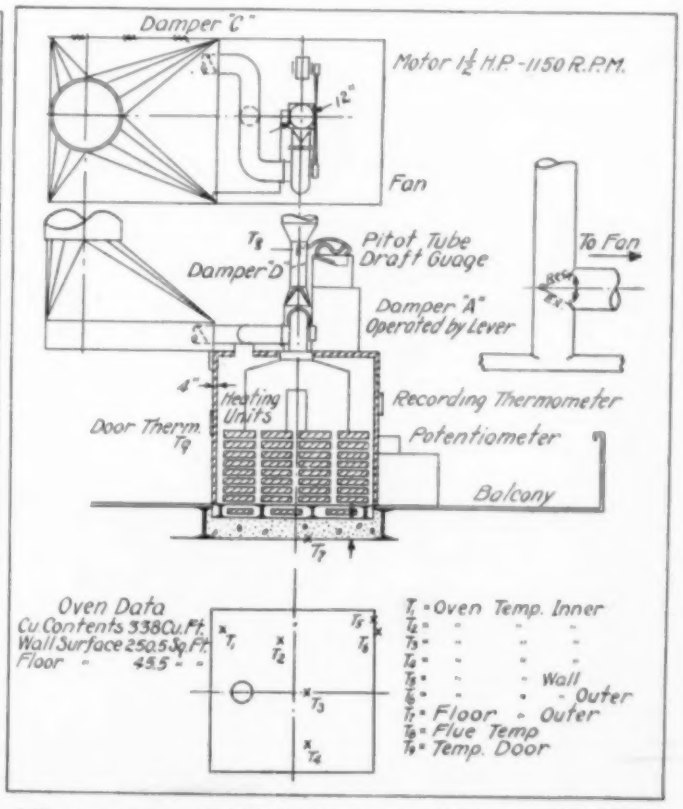
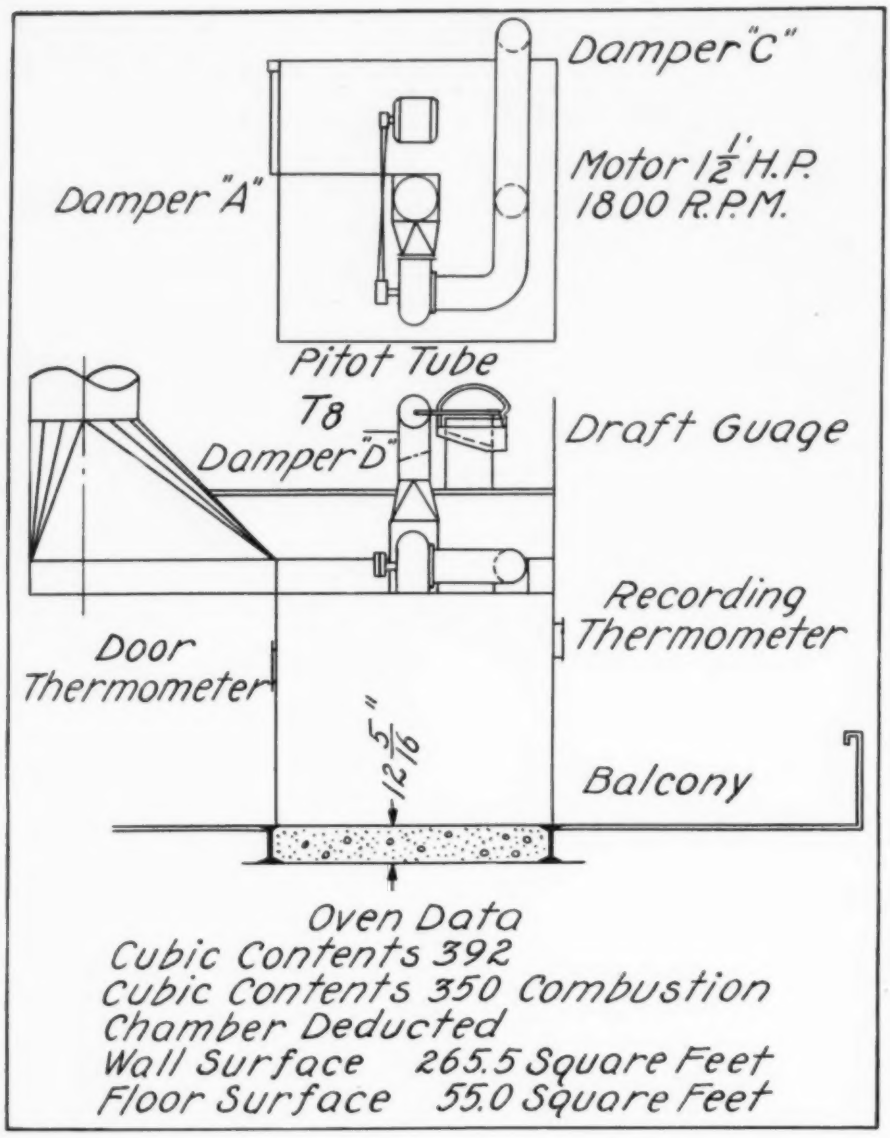


FIG. 2—ARRANGEMENT OF OVEN, *B*, EMPLOYING ELECTRIC HEAT



ARRANGEMENT OF OVEN *C*, USING OIL FUEL FOR HEATING

It is essential that the various values governing the preceding points be pretty closely approximated to arrive at correct results in estimating heating capacity.

The results could be made exceedingly close in experimental work where test boxes are used. However, our problem differs materially in that we had widely varying conditions and application to actual practice. The necessity of the fundamental theory will be clearly illustrated.

Figs. 1, 2 and 3 illustrate the general arrangement of various ovens and testing equipment. The illustrations give a clear conception of the oven installation, and of the other important features. Oven *A* was constructed of light sheet metal walls separated by two inches of asbestos insulation. The design is indicated in Fig. 1.

An exhaust fan was connected to flues, extending down the sides of the oven. The construction was such as to allow the return air to pass over the floor heating units. Dampers were provided for at *A*, *C* and *D*. Damper *A* acted as a by-pass so that the air could either be exhausted or recirculated. Damper *C* controlled a fresh air inlet. Damper *D* functioned merely as a secondary damper. Damper *A* was operated by means of a series of levers and rod at the oven front. By means of various notches, used as indicators for varying damper openings, the flow of air was fairly well controlled as desired. The hood functioned to remove such gases as might escape around the doors.

The heating equipment was of approximately 86-kilowatt capacity, with the units arranged as in the sketch, Fig. 1. The control consisted of one 100-kilowatt automatic control panel operated in conjunction with a thermostat and relay, 440-volt, 3-phase, 60-cycle current being used. The floors were constructed of I-beams and concrete (mezzanine floor) as indicated in Fig. 1.

Oven *B* was constructed of light sheet metal walls, separated by 4 inches of block, consisting of diatomaceous earth. In general the other arrangements were similar to those in oven *A*. The heating units, however, were arranged more evenly and with better effect. The capacity was equal to that of oven *A*.

Oven *C* was constructed of the same material as oven *A*. Excepting for the heating equipment the arrangement of oven *C* was also similar to oven *A*. Instead of electric heat, this oven was provided with a firebrick combustion chamber on each side of the oven, together with a 3/4-inch high-pressure oil burner for each chamber. Owing to the space occupied by the combustion chamber the oven size was somewhat greater than that of either oven *A* or *B*.

Figs. 1, 2 and 3 illustrate the various test instruments used, including pitot

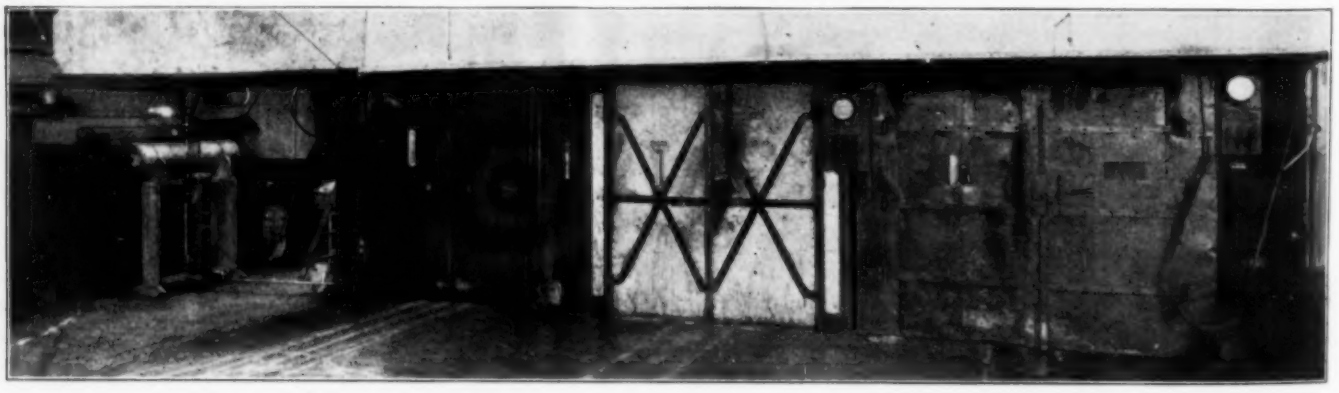


FIG. 4—FROM LEFT TO RIGHT ARE SHOWN THE OIL EQUIPMENT, OVEN *C*, OVEN *A*, CONTROL PANEL, AND OVEN *B*

tubes, thermometers and potentiometer. During the tests other instruments, such as anemometers, orsat apparatus, etc., were used with varying grades of success. The equipment of greatest advantage included thermometers, oil measuring equipment and watt-hour meters. The results given are based principally on the use of these instruments.

The points most carefully investigated may be numbered as follows:

Radiation losses (including leakage ventilation).
Ventilation losses and observations.
Heating requirements.
Comparative qualities of ovens.

*The potentiometer leads were carefully located at various points in the oven to obtain a fair average inner temperature value. One lead also was located in the exhaust flue to obtain the temperature of the exhausting air. A lead was fastened as closely as possible to the inner metal surface, precaution in the form of a thin sheet of mica being taken to prevent short circuiting the potentiometer leads. Directly under the oven and fastened to the concrete a similar arrangement was made.

With the exception of the necessary internal oven equipment the oven was tested with no load inside. The temperature was allowed to build up to the desired degree to be maintained, and the thermostat was then adjusted to maintain an average temperature as required. Some little time elapses before complete absorption takes place and the oven reaches equilibrium, as is evidenced by the curves, Figs. 7 and 8.

Since the determination of the radiation losses is influenced by any possible heat loss through air leakage, every probable source of leakage must be sought out and eliminated within practicable limits.

For some time, the records were noted in tabular form. After the work seemed to be progressing favorably it was decided to discard the tabular forms and the data were directly transformed into curves. This procedure allowed for excellent comparison of two ovens in simultaneous operation, as well as to indicate graphically the occurrences as the tests advanced.

By carefully examining Figs. 7 and 8, each successive step may be traced. The current was started at a convenient time with the oven at room temperature (averaging about 65 degrees Fahr.). In each case the uniformity of temperature rise is conspicuous and the time interval between the final temperature of 400 degrees (angle type thermometer) and the initial oven temperature, 65 degrees, proved always to be nearly the same.

The average time consumed was 26.7 minutes for oven *A* with a 2-inch wall; the average power consumption amounted to 45.7 kilowatts.

On the other hand oven *B* with a 4-inch wall required an average time of 28 minutes and an average power consumption of 47.9 kilowatts.

These comparative results are interesting, since the facts are so consistent, and indicate that the thicker walls absorbed a greater amount of heat initially than the lighter walled oven.

Continued inspection after the 400-degree temperature was reached showed that with all dampers closed, fan off, considerable power and time were consumed before the point of equilibrium was approached.

Referring to Fig. 7, oven *A* in the second 31 minutes consumed 17.3 kilowatts, in the third 30 minutes only 13.9 kilowatts and so on until 12.9 kilowatts was reached. The correct average loss was about 12.6 kilowatts radiation loss in 30 minutes or 25.2 kilowatts per hour.

The power consumption for oven *B* took a decided drop after the 400-degree temperature was reached, indicating over the second 30 minutes a smaller loss than occurred over the corresponding interval for oven *B*. This fact would indicate in the case of the thicker wall that the rapidity, with which the absorption reached equilibrium, was greater than that of the 2-inch, which together with the lower radiation rate, resulted in a smaller current consumption. The radiation loss for the 4-inch wall averaged 21 kilowatts per hour in these investigations.

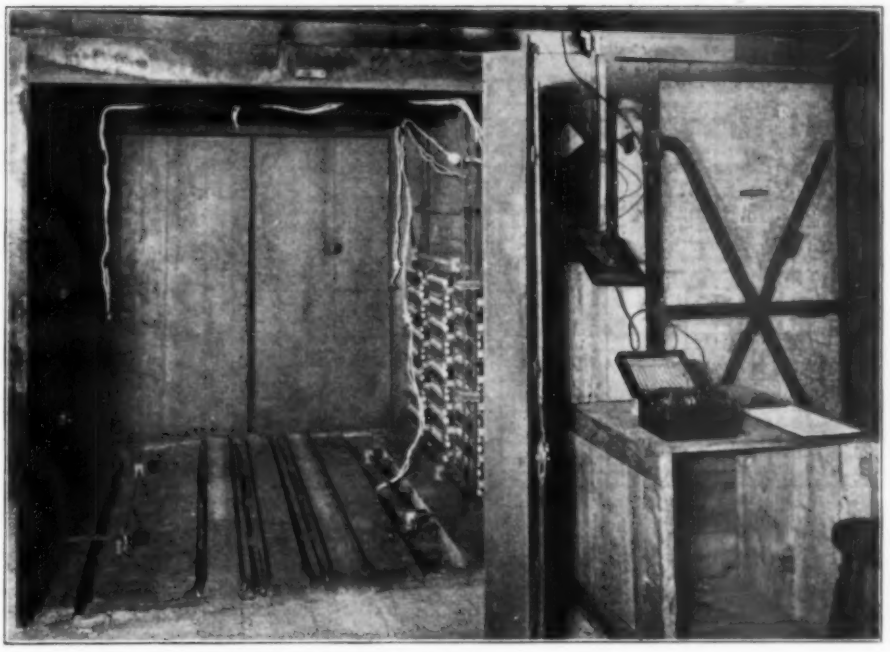


FIG. 5—INSIDE OF OVEN AT THE LEFT SHOWING ARRANGEMENT OF THERMOCOUPLES—PYROMETER INSTRUMENT AT THE RIGHT

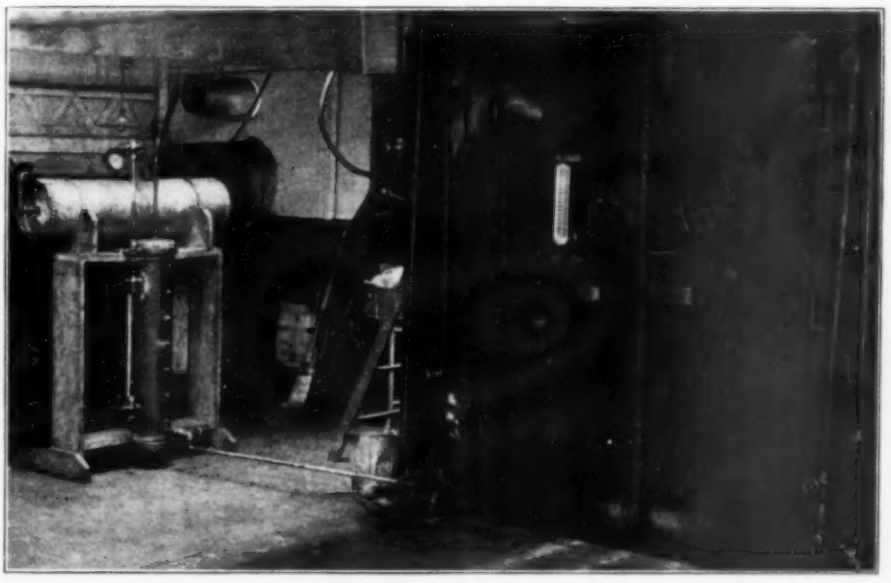
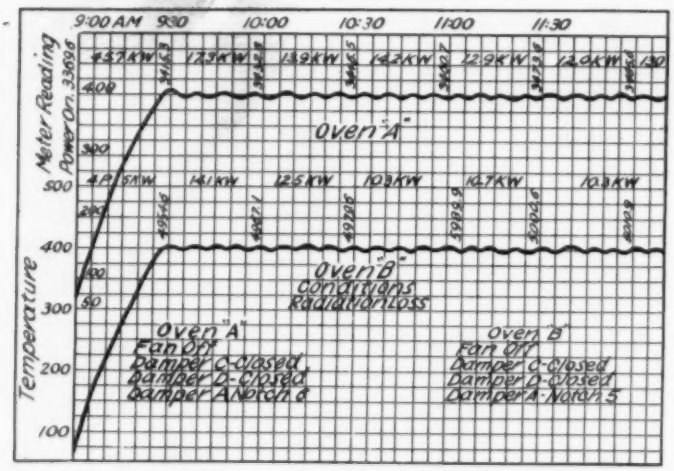


FIG. 6—OIL MEASURING EQUIPMENT AT THE LEFT—OIL FIRED OVEN AT THE RIGHT

*These readings are not indicated in this paper.



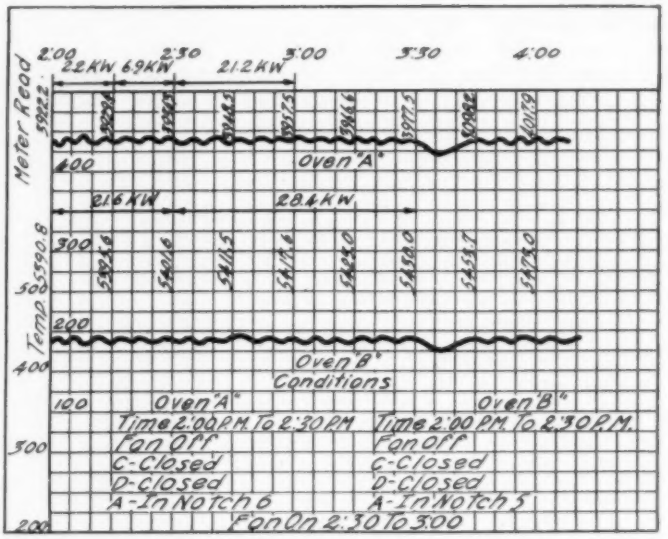


FIG. 7—ABOVE—AND FIG. 8—AT THE RIGHT—CURVES SHOWING RADIATION LOSSES OF OVENS *A* AND *B*

Thus the transmission efficiency of the 4-inch wall and the 2-inch wall compare in the relation of $\frac{21.0}{25.2}$. This would indicate that the 4-inch wall, used under the same *practical* conditions as the 2-inch wall, was approximately 16.6 per cent more efficient. Fig. 18 illustrates the difference between an ideal insulation test as the writer found it and that obtained in actual practice. There is ample evidence that it would be difficult to obtain the ideal results in practice.

The results obtained in regard to uniformity of temperatures, once the desired temperature was arrived at, were good. It was particularly noted, however, with ovens of the size tested that difficulty is encountered if temperatures less than 430 degrees Fahr. are adopted as the best temperatures.

According to Fig. 9 about 53 minutes are required to reach 450 degrees Fahr. However, by comparing Figs. 9 and 10 it may be noted that the initial heating is variable. This is readily comprehended due to the fact that the burner operation fluctuates constantly during heating.

Of course, an attempt to obtain a radiation loss with direct heating equipment, where actual combustion occurs, is impossible, owing to the necessity of ventilation. Similarly recirculation of the heat would be impractical owing to the back pressure exerted on the oil burners. Therefore, the losses indicated by the curves are a summation of the wall and ventilation losses.

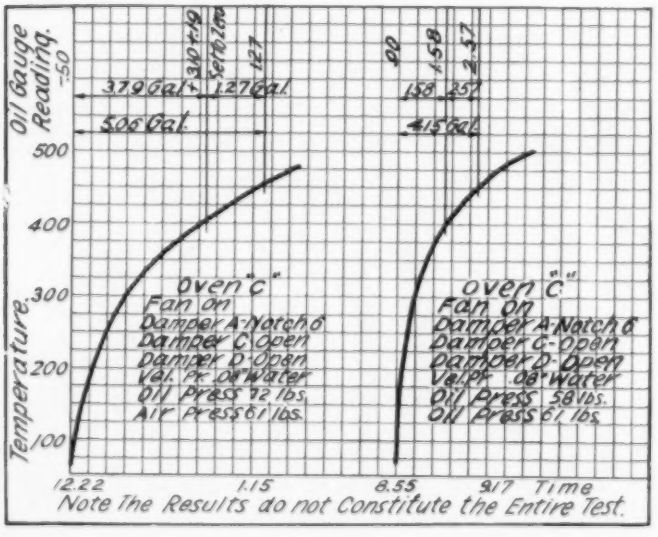
The accompanying tables disclose some interesting points regarding the losses corresponding to variation in ventilating capacity. Particular mention is made in the case of the electric ovens *A* and *B*: after every precaution has been taken to eliminate leaks, all dampers closed and the fan off—as expected the kilowatt

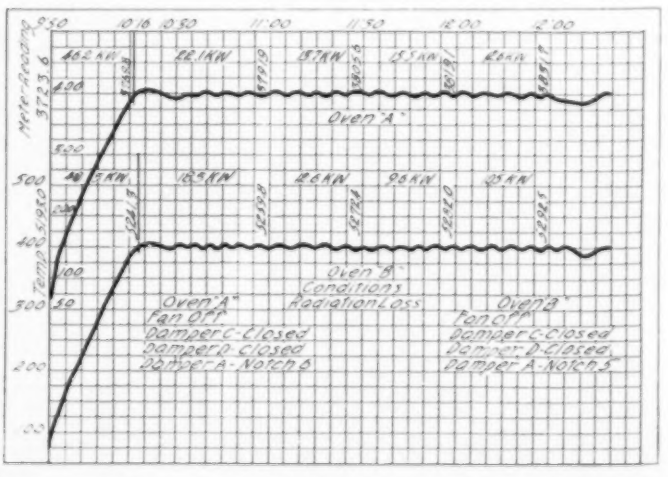
Table I

Heat Losses in Three Ovens

Condition	Notch	Kilowatt loss per hour	B.t.u. a square foot per hour	Gallon oil per hour	Temperature at door	Velocity pressure inches water
			Oven A			
Fan off.....	6 r	25.2	300	....	400	0
Fan on.....	6 r	33.4	399	....	400	0
Fan off.....	6 r	28.2	336	....	440	0
Fan on.....	6 r	42.4	507	....	440	0
			Oven B			
Fan off.....	5 r	21.0	242	....	400	0
Fan on.....	5 r	22.0	254	....	400	0
Fan on.....	1 ex	27.4	316	....	400	.05
Fan off.....	5 r	21.6	249	....	440	0
Fan on.....	5 r	28.4	327	....	440	0
			Oven C			
Fan off.....	6 ex	39.7*	423	.94	430	0
Fan on.....	1 r	71.2	756	1.72	430	0
Fan on.....	6 ex	97.0	1030	2.30	450	.04

Note:—6r, 5r and 1r indicate dampers in maximum recirculation position and with fan off represent minimum ventilation. 6ex and 1ex where mentioned are indications of wide open exhaust dampers. *Equivalent kilowatt consumption.





FIGS. 9 AND 10—AT THE LEFT—TEMPERATURE AND TIME DIAGRAMS OF OVEN *C*. FIG. 11—FUEL CONSUMPTION OF OVENS *A* AND *B*

loss is a minimum, as indicated in Figs. 7, 8, 11.

It often is presumed that by recirculation, heat is converted, whereas from inspection, it is observed that with the fan on and main damper in notch No. 6 (recirculating) in the case of the oven *A* a difference of 33.4 and 25.2, or 8.2 kilowatts is lost in addition to the radiation loss. This figure is extremely high as compared with that for oven *B*, and would indicate that there was a source of heat loss through leakage which was not remedied in this case. If it were practically possible to avoid all usual sources of leakage no appreciable saving in heat would be possible by recirculation. Where leakages are presented a fan merely is transformed into a blower and the tendency of stirring up the air is to move the warm air to colder regions.

Similar trials were made with the oil burning oven, showing in Figs. 12, 13 and Table I. These trials indicated that a natural draft condition proved most economical in fuel consumption. The amount of air passing through the vent pipes was too small to be recorded. It may be noted that the recirculation method allowed an appreciable amount of air flow and resulted in a rather great fuel consumption as compared with the natural draft result. The temperature maintained in the case of the oil burning oven was approximately 430 degrees Fahr.

Attention is called to the resulting fuel consumption conditions of ovens *A*, *B* and *C* when the minimum amounts of ventilation are prevailing at approximately 440 degrees.

	Equivalent kilowatt loss per hour	Temperature	Gallons oil per hour	B.t.u. loss per sq. hour per square foot
Oven A (Fig. 11)				
Fan off 6 recirculating	28.2	440	..	336
Fan on 6 recirculating	42.4	440	..	507
Oven B (Fig. 11)				
Fan off 5 r.	21.6	440	..	249
Fan on 5 r.	28.4	440	..	327
Oven C (Figs. 12 and 13)				
Fan off 6 ex.	39.7	430	.94	423
Fan on 1 r.	71.2	430	1.72	756

Hydraulic Cylinder Is Coarse Grained

Question: Recently we cast a hydraulic cylinder 6-inch bore, 2½-inch thickness of metal. We also cast a solid ram 4 feet long, 10 inches in diameter with a head 2 feet in diameter. The cylinder was cast horizontally and the ram was cast vertically, both in dry sand molds. The cylinder weighed about 2800 pounds and the ram about 700 pounds. The castings were poured from a mixture made up of 60 per cent hematite pig iron Nos. 1, 2 and 3 as they are graded in this district and 40 per cent hydraulic cylinder scrap. These cylinders were made during the war period and used for shell making. From this mixture I anticipated a silicon content of approximately 1.50 per cent. When the castings were machined the grain showed up little coarse except in patches where it appeared quite close and shiny. At first the cylinder leaked a little under pressure but this was remedied by tapping. Kindly give us your opinion on the probable cause of the trouble.

Answer: From the fact that the grain was coarse and that the casting leaked under pressure it is apparent that the silicon content of your iron is too high. Theoretically your mixture of 60 per cent pig iron and 40 per cent hydraulic cylinder scrap should have produced a hydraulic cylinder having the same general characteristics as the scrap castings and since they had been in successful operation you were justified in assuming that the new casting would be satisfactory. However, in the light of your experience it would be advisable to reverse the proportions of your mixture and use 40 per cent pig iron and 60 per cent scrap. You do not say anything about steel and we do not know whether or not you are familiar with its use. With 40 per cent hematite pig iron, 40 per cent good machinery scrap and 20 per cent steel scrap melted exceedingly hot with good coke you should get a cylinder easy to machine and yet one in which the grain would polish like silver. The silicon content for a cylinder having a 2½-inch wall need not exceed 1.50 per cent with the other elements approximately as follows: sulphur 0.10 per cent; phosphorus 0.60 per cent; manganese 0.90 per cent. The manganese content may be raised either by charging ferromanganese in the cupola in lump form or by adding it to the stream of iron from the spout in pulverized form.

Suitable Fan for Cupola

Question: We are installing a small cupola, 28 inches inside the lining, five tuyeres, 4½ x 9 inches, and would appreciate information in connection with the fan. The size, speed, air delivery and horsepower required.

Answer: The different manufacturers of cupola blowers and fans have not adopted an arbitrary set of numbers to designate the fan capacity in cubic feet of air delivered per minute. Thus a No. 6 fan in one manufacturer's catalog would have reference to a blower capable of delivering 1400 cubic feet of air per minute while running at 4000 revolutions and a similar number in a second catalog might refer to a fan with only half that capacity. A 28-inch cupola operating under favorable conditions has a melting capacity of approximately 3½ tons of iron per hour. Each ton of iron melted requires 30,000 cubic feet of air, or a total of 105,000 cubic feet. Your problem, therefore, resolves itself into securing a fan capable of delivering 105,000 cubic feet of air per hour, or 105,000 ÷ 60 = 1750 cubic feet per minute. Manufacturers of blowing equipment, whose address may be found in the advertising pages of THE FOUNDRY, have all these details worked out and tabulated and will be glad to supply any necessary information on request.

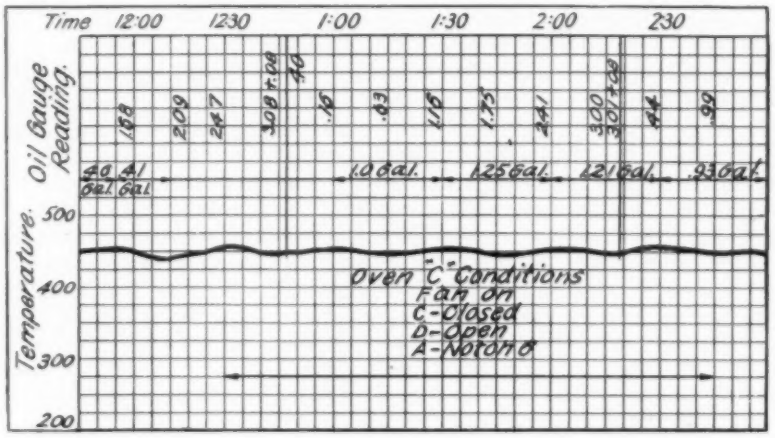


FIG. 12—OPERATION DATA ON OVEN *C*

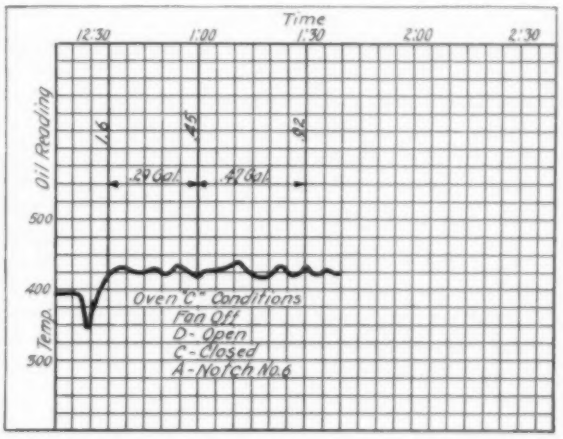


FIG. 13—ADDITIONAL DATA ON OVEN *C*

Protecting Workmen's Eyes

Prevention of Accidents in the Foundry, Mill and Metal Working Plants with Special Reference To the Field of Eye Protection and Safe Clothing Are Discussed

BY BUELL W. NUTT

OF ALL the nonfatal accidents which occur, eye accidents are among the most numerous and most costly of all. It is estimated that at least 20 per cent of all these nonfatal accidents are eye accidents, and that of the eye accidents, probably 28 per cent result in the loss of one eye and 10 per cent in the loss of both eyes, while many of these accidents impair the vision to a lesser or greater degree, cause a great deal of suffering, result in much lost time, and are a very great expense to the employer, and often to the community. The sad part of all this is that eye accidents, of all accidents, are probably the easiest to prevent, and it is conservatively estimated that at least 95 per cent of them can be eliminated by the use of proper goggles, or by the use of various types of masks, hoods, and helmets.

In visiting hundreds of plants during the past six years the author has found that while at first it was sometimes difficult to convince an employer to provide goggles for his employes, most employers now do not hesitate to buy goggles. The greatest problem with them today seems to be the question of how to get the men to wear the goggles after they have been supplied. A great many workmen in all kinds of plants interviewed in an endeavor to find out why they do not want to wear goggles, and their objections have been sifted down to about three general complaints as follows:

1. They are afraid that the glass may be broken and driven into the eye.
2. They complain that goggles are uncomfortable and hurt their noses, cheeks and ears.
3. They complain that goggles give them headaches or prevent them from seeing properly.

Various Considerations

In considering these complaints: first we have fear of broken lenses. No workman now need be afraid to wear goggles of the better or standard grades, because the frames are substantially made and the lenses used are especially ground to withstand heavy blows without breaking. Two general types of lenses are used for chipping and grinding goggles; one an optical glass which is ground, polished and especially annealed which makes it a great deal stronger than ordinary glass, and the second type a lens constructed to two separate sheets of glass between which a sheet of celluloid is placed, the three being welded together into one solid lens. A lens of this character even when cracked by a heavy blow will not separate. Therefore, if workmen are provided with goggles of a standard make, they may be assured that they will have no trouble from broken glass being driven into the eye with the resultant loss of vision.

Uncomfortable Goggles

Second, we have the complaint of discomfort, and in the author's judgment this is the greatest obstacle of all to the wearing of goggles. We cannot expect men to wear goggles that are uncomfortable and which hurt their noses, cheeks or ears. To eliminate this complaint the right type of goggles must be selected for the particular work in hand. For grinders, chippers and similar operators the spectacle form of goggles fitted with side screens is the best. It also is best to select one which readily may be adjusted, so that it may be easily fitted to the contour of the nose, cheek and face. No two faces are just alike, and to make goggles comfortable care must be exercised to see that they are properly fitted. Adjusting the nose piece or temples usually will change an uncomfortable goggle to a comfortable one, and one which workmen will wear without complaint. It is good practice to have one man in each plant who has had some instructions in the use and care of goggles supervise their distribution. He can see that each man is properly fitted and can look after the repairs and sterilization.

Third, we have the complaint that goggles cause headaches and prevent clear vision. The headache part of this complaint frequently is due to the poor adjustment which causes undue pressure on the nose or cheeks. Proper adjustment will overcome this. Sometimes men also will tell you that they cannot see plainly when wearing goggles. As a matter of fact the lenses in the better grade goggles never obscure vision and will neither add to, or detract from a man's vision—the chances are that the man who makes this complaint has defective eyesight. A man who has poor vision is not always a safe man to have around a plant, neither is he efficient. Eye strain produces fatigue, dizziness, headaches ,and causes a slowing up of the worker, as he cannot see his work properly. It also results in a drain of nervous energy with the result that the functions of other parts of the body must suffer in consequence, and thereby lower the vitality and efficiency. After the age of 35 to 40 years, the near-point vision begins to dim, and when this has started the only way to overcome it is to have lenses fitted, which, in a sense, restores the vision to its former keenness. In those below 35 years of age other defects of vision may occur which may be corrected just as easily by proper lenses. To give a man goggles fitted with plain glass and expect him to use them, regardless of the fact that he may have poor vision, many times places him under a handicap. Many complaints that goggles cause headaches, dim vision or that they hurt the eyes can be traced to this source.

Loss of One Eye

Man is equipped with what is known as binocular vision; that is, he uses both eyes at the same time, to look at the same object, and by this method is enabled more accurately to tell direction and judge distance and the size of objects. The loss of an eye, therefore, upsets the whole scheme of his vision, and as a result he not only loses 50 per cent of his sight, but far more, as the remaining eye cannot function properly by itself. Therefore the ability to judge direction and distance correctly is largely lost to the individual with only one eye. Thus, too, many people who have normal vision in one eye and defective vision in the other are not aware of the fact, and frequently poor vision in both eyes is not detected. Such employes are a source of danger, not only to themselves, but to their fellow workmen. It pays to know that men in your employ have good eyesight, and it pays to provide goggles fitted with corrective lenses when you find a workman

From a paper presented at the convention of the American Foundrymen's association held at Rochester, N. Y. The author is connected with the Safety Equipment Service Co., Cleveland.

suffering from poor vision, because improved vision not only makes a more proficient worker, but it often overcomes the objection to wearing goggles. A man's vision easily may be determined by means of a simple chart which can be used by any clerk in the employment department.

Certain kinds of work exposes the eyes of workers to intense heat and light. Welders, metal pourers, furnace men and others, therefore, must be provided with goggles or masks containing specially colored lenses to keep out the dangerous rays of light which are present in all forms of artificial as well as natural light.

For sand blasting and other dusty operations hoods of various styles are available which keep out dust, dirt or sand. Likewise respirators and gas masks of various types should be provided for men subject to dust, fumes, gas or smoke. Giving a little thought to the proper selection of the type of eye protection required and some personal attention in seeing that men are properly fitted usually will solve the problems of eye protection.

The question of safe clothing in the foundry means first the elimination as far as possible of thin, ragged, greasy, loose, and baggy clothing, and worn-out or laced shoes. Men should be urged to wear the one-piece suit where possible, as it eliminates much of the hazard from loose, ragged clothing. Fire-proofed duck suits of the one-piece variety make the safest and most practical suits to use. They will shed sparks and small spatters of metal and will not burn readily. Asbestos suits also can be secured, and are sometimes necessary. Safety shoes are also essential and at any rate the use of lace shoes should be prohibited. The proper leggings also should be provided to prevent the burning of legs and feet. There are numerous types of leggings which are practical and which absolutely will prevent burns.

For workmen handling ladles ,or hot metals of any kind, also for welders and other operators, asbestos gloves, leg pads and aprons are available, and should be provided. It may cost a little to provide these things, but it never costs as much as paying for burns or other accidents which may happen. Many cuts and abrasions of the hands can be prevented by providing leather gloves of special designs. Frequently it is necessary to provide also sleevelets where special protection is required for a man's arms.

An example of what may happen when proper clothing is not provided is illustrated by a recent occurrence in a prominent midwest foundry where a workman pouring a mold was surrounded by a shower of sparks and a spatter of red hot metal. To protect his clothing the man had secured a burlap bag and tied about his body like an apron. No cord or string being handy, he fastened the bag around his body with a piece of wire. The bag had become greasy and oily and during one of the pouring operations a spark lodged in it and in a few seconds he was enveloped in flames. Fellow workmen tried to extinguish them but the bag was wired to the man's body and before it could be removed he was so badly burned that he died in great agony a few hours later. The man lost his life, his wife was made a widow, his seven minor children were left without his protection and it cost the company several thousand dollars, all because he had not been provided with a fireproof suit or an asbestos apron that at most would not have cost over five dollars.

Do not let a man work around your plant with ragged clothing, worn-out shoes, or covered with makeshift protection. The best protection you can get is none too good and its cost is many times less than accident costs. Whatever is paid out in money as compensation never squares the account because a human suffering and death never can be measured by a dollars and cents standard.

Pattern Must Suit Foundry Conditions

BY M. E. DUGGAN

SEVERAL mistakes were made by the patternmaker before a satisfactory pattern and corebox were made for the castings shown in the accompanying illustration. An even distribution of metal was essential in this casting which also had to be clean and free from any interior defects. The first pattern was made split through the center to be molded horizontally, one half in the drag and the second half in the cope. A core print 4 inches long was provided at each end. To form the rings shown at *E*, Figs. 1 and 2, loose half rings were attached to the half corebox by wire brads in the usual manner. The half ring pattern to remain in the core until after it was rolled over on the plate and then drawn laterally after the half corebox was removed. Castings poured horizontally were not satisfactory. Even with bearings on the core prints and a chaplet in the center it was found that the thickness of metal varied 3/32-inch between the top and the bottom.

The pattern was returned to the pattern shop with instructions to adjust it for vertical molding. It was suggested that a large flat print be nailed on the bottom of the pattern and a second similar print be nailed on the top. This feature is shown at *C* and *D*, Fig. 1. It was claimed that this large print area was necessary to maintain the core in its proper position in the mold. The print *D* was made the full diameter of the pattern and consequently the core scraped sand from the sides of the mold all the way down. It had to be taken out and the print filed. Thus, whatever value it had for accuracy was destroyed. The print *C* is in the cope and therefore if the cope shifted in closing, the core was carried with it and produced a casting with walls of uneven thickness.

The manner in which the additional core print was added to the corebox is shown in the left hand part of Fig. 3. The print *I* Fig. 3 is only 1 inch thick and the ring *E* is 1/4 inch thick. The patternmaker overlooked this point in sending the corebox to the foundry where manifestly it was impossible to pull a 1 3/4-inch ring out through a 1-inch gap. However, the coremaker solved this trouble in a rough and ready foundry fashion by breaking the ring in two before placing it in the corebox. Then after the box was rammed full of sand he pulled the parts out after the manner of horn sprues and filled the cavity with dry sharp sand before rolling the corebox and core, over on the plate.

Finally a method was adopted which simplified the molding and insured a centrally located core. Two round slab coreboxes were made, one 4 inches larger in diameter than the small end of the pattern and the other 4 inches larger than the wide end of the pattern.

The small corebox was provided in the center with a 3-inch print and the large corebox with a 4-inch print. Thus when the cores were made and dried the smaller had an opening to fit over the 3-inch core print on the bottom of the pattern and the larger had a similar opening to fit over the 4-inch core print on the top. The prints in each case were made the same depth as the thickness of the slab cores. In molding the job the two slab cores were placed in their respective positions on the pattern which then was placed in a drag, covered with rammed sand and rolled over. A piece of iron plate was rammed on

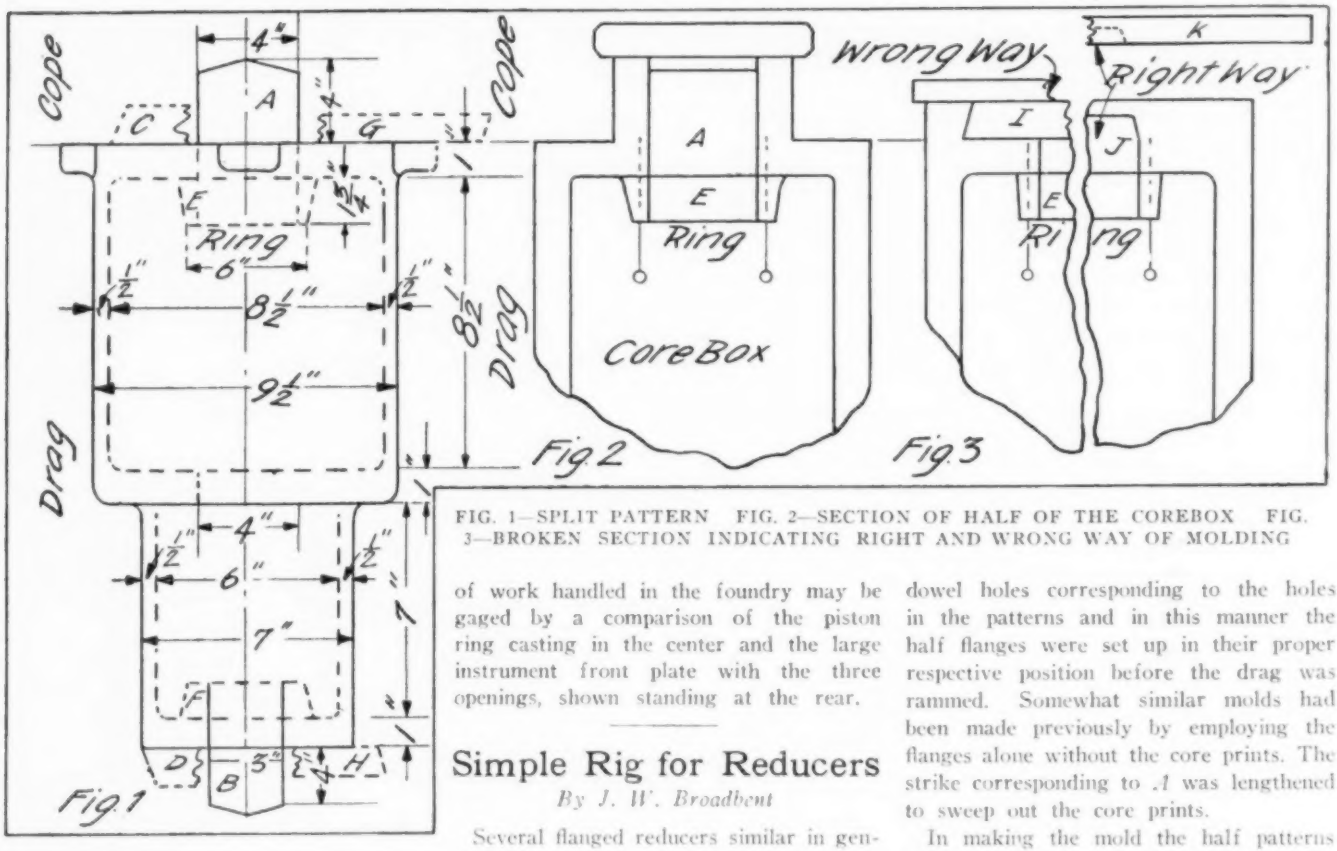


FIG. 1—SPLIT PATTERN FIG. 2—SECTION OF HALF OF THE COREBOX FIG. 3—BROKEN SECTION INDICATING RIGHT AND WRONG WAY OF MOLDING

top of the lower print before the drag was quite filled with sand. This plate later served to support the weight of the core. After the drag was rolled over, the upper slab core was lifted out and set to one side. The pattern then was drawn, and after the mold was finished and the center core set, the slab core was replaced; all simple and ship shape, no trouble to set the core and no possibility of it shifting out of position after it was set.

Make Castings that Are Smooth and True

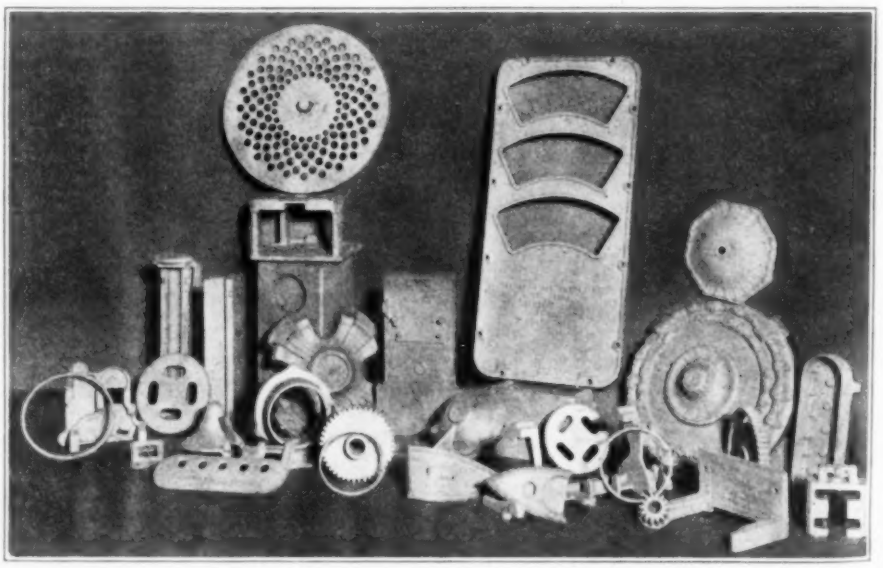
New England gray iron foundries long have had a reputation for turning out exceptionally high quality castings. The examples shown in the accompanying illustration were selected from a wide variety of light and intricate castings made by a Connecticut foundry which specializes in high grade work of that character. The perforated disk at the upper right hand corner is a phonograph turntable on which disk records are mounted. It is only 1/8-inch thick and must be absolutely true and accurate in size and shape and in addition the metal must be close and homogenous. The most minute flaw or surface imperfection destroys its acoustic properties. Few of the castings made in this foundry receive any machine finish, they are fit to go into service immediately after they leave the foundry. The large lamp base shown on the right is cast from an original model supplied by the artist. The range of work handled in the foundry may be gaged by a comparison of the piston ring casting in the center and the large instrument front plate with the three openings, shown standing at the rear.

Simple Rig for Reducers

By J. W. Broadbent

Several flanged reducers similar in general features to the one shown in the illustration, but of unusual dimensions, 4½ x 5 inches, 3½ x 5 inches, 3 x 4 inches, etc., were ordered and since only one or two castings were required in each case it was not considered advisable to provide expensive pattern equipment. Furthermore, it was extremely improbable that a repeat order ever would be received. A pair of flanges and core prints were turned up for each size. They were made in halves and doweled in the ordinary manner. The pattern board on which all the molds were rammed was provided with dowel holes corresponding to the holes in the patterns and in this manner the half flanges were set up in their proper respective position before the drag was rammed. Somewhat similar molds had been made previously by employing the flanges alone without the core prints. The strike corresponding to *A* was lengthened to sweep out the core prints.

In making the mold the half patterns containing the pins were laid on the board. The drag was rammed and rolled over and the second halves of the patterns were set on in the usual manner. After the cope was rammed and lifted off the space between the flanges in both cope and drag, was swept out by the piece *A* which works in suitable recesses in the flanges as indicated in the dotted lines, Fig. 2. The core was made in halves and pasted. A skeleton frame was provided, made up of two semicircular ends, *SS*, corresponding to the diameter of the two core prints, joined together by two flat



EXCEEDINGLY SMOOTH SKIN TOGETHER WITH ACCURACY OF SHAPE AND DIMENSIONS ARE CHARACTERISTIC OF CASTINGS MADE IN A NEW ENGLAND FOUNDRY

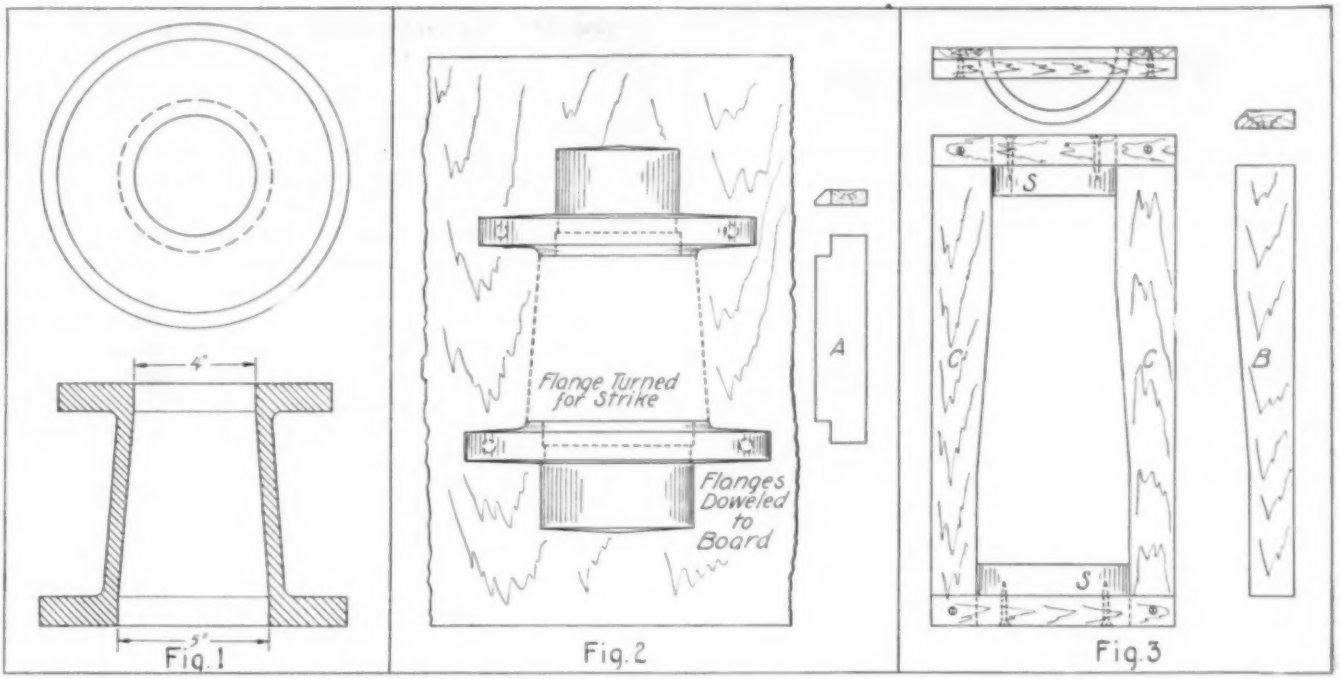


FIG. 1—PLAN AND SECTIONAL VIEW OF CASTING FIG. 2—FLANGES AND CORE PRINTS ARRANGED ON ROLLOVER BOARD FIG. 3—SKELETON COREBOX AND SWEEP FOR MAKING THE HALF CORE

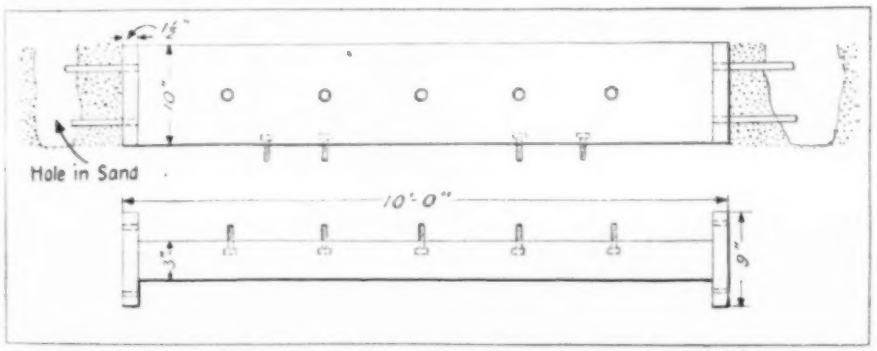
strips, ⅜-inch x 4 inches, *CC*. These side pieces were arranged to impart a true outline to the core at the joint line and the sweep *B* was employed to shape the remaining surface of the core.

Core Oven Car Repairs Made in Foundry

By John W. Robertson

An interesting example of foundry emergency repairs is shown in the accompanying illustration. One of the cars in the dry sand mold oven showed such serious defects in the two side members that it was considered unsafe for further use. At the time the trouble developed, work was piled up at the plant and the loss of the car meant a serious delay. Therefore, it was decided to repair it in the foundry if possible. The car approximately 9 x 10 feet was built of the usual steel channel beams. The two defective pieces ran parallel to the tracks and on their under sides carried the wheel bearings. The car was measured carefully between the outside frames and a hurry call sent to the pattern shop for a rough pattern made exactly to the dimension supplied. Upon receipt of the pattern, two molders bedded it in the floor twice for two open sand molds. A number of ⅝-inch bolts had been gathered in readiness and as the job progressed, core prints were provided to match the holes in the car frame. While ramming sand around the ends of the pattern, four pieces of 13/16-inch doweling, 6 inches long, were laid end on, squared and levelled to match the holes in the ends of the frame. Before the pattern was drawn, a hole was made in the sand about 6 inches away from each end. This exposed the ends of the dowel pins and after the pattern was drawn, they were backed out easily. Lengths of ¾-inch cores were pushed in the openings left by the dowel pins until they passed entirely through the thickness of the flange. This method insured accurate holes, square and in line and also prevented any marring of the face of the flange. Bolts were bedded in the bottom of the mold in positions corresponding to the holes in the wheel bearings. Other bolts were inserted midway between the top and bottom along the sides, for fastening the cross braces.

The castings were allowed to cool overnight in the sand. In the meantime the old car had been turned over and the wheels, bearings and defective supports removed by an acetylene torch. The new side frames, after being lifted out of the sand and cleaned, fitted in place as though they had been machined. The wheel bearings, wheels, end and cross braces, all, quickly were replaced and bolted in position. The car was taken from the oven in a damaged condition one morning and was back on the job in good condition the following morning.



HOW SIDE FRAMES FOR A CORE OVEN CAR WERE REPAIRED

Explains Coal Situation

The coal situation was explained to the Philadelphia foundrymen at their regular monthly meeting of their association, held Oct. 11, at the Manufacturers' club of that city, by Noah H. Swayne, ex-president of the National Coal association, who was the speaker of the evening.

Fred M. Devlin, president of the Philadelphia Hardware & Malleable Iron Co. of Philadelphia was appointed to fill the unexpired term as president of the association of his father, Thomas Devlin, who died in June last. The secretary, Howard Evans announced his new address to be the Union League, Broad and Sanson streets.

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Mass Production and Accuracy

TO MEET successfully the demands of repetition work, special methods involving radical departures from common practice were developed and introduced. It was realized that the human factor could not be dispensed with altogether, but it was felt that by providing suitable mechanical equipment the output from each operator could be increased to a remarkable degree without any deterioration in quality. Further, as the scope of mechanical equipment was extended, it was found that the processes involved in making molds could be divided into many elements and each of these elements could be handled by a different operator. Where formerly a period of four years was required to develop a molder competent to begin and finish his work, under the system in vogue in specialty shops, ordinary labor is taught in a few hours to fill the place of any missing link in the long chain of production. This illustrates the feasibility and flexibility of the production system and it also goes to show that while molding skill, manual dexterity and mature judgment on the part of the operators are regarded as essential in a jobbing shop, they are neither an asset nor a necessity in a specialty foundry. Power driven equipment, accurate patterns and flasks, and mechanical appliances for handling materials have reduced the personal equation and have placed the manufacture of certain kinds of castings on a mechanically automatic basis.

Watch High Silicon Scrap

BACK scrap can be added to the cupola with assurance that the foundryman will get a metal of the composition he has calculated, but when he buys foreign scrap an element of uncertainty, as to its composition, enters. Of course, in carefully selected machinery scrap, a close estimate of its composition can be made, as also is the case in any uniform grade of metal such as rolls, car wheels, stove plate, etc. In the latter case one sometimes gets a highly oxidized iron which may cause trouble, but this is expected and can be detected in time to eliminate the objectional pieces. However, in purchasing a medley of mixed gray-iron scrap the foundryman takes wide chances. Recently these chances have been made more hazardous by the scrapping of a large amount of nitric acid stills and other acid resisting castings containing 13 to 14 per cent of silicon. Sometimes enough scrap castings are obtained to make a carload shipment which can be sold as high-silicon scrap in which case it can be intelligently used. However, in the majority of cases only a small lot of high-silicon castings are secured and they are thrown in with other scrap and sold to the dealer who may not know it, or, if he does, may not realize the importance of separating the high-silicon iron from the regular gray-iron scrap. In this case it goes to the foundryman along with the other metal and is calculated in the mixture as probably 2.00 per cent silicon iron instead of 14.00 per cent silicon iron as it really is. This metal can be detected from the nature of its fracture which looks much like the regular ferrosilicon fracture; also the metal is brittle and easily broken. With these facts in view the foundrymen should have all shipments of foreign scrap examined closely.

Trade Outlook in the Foundry Industry

SEPTEMBER'S high record in industrial activities seems to have set the mark for October and in castings manufacture the regular seasonal advance gives promise of bringing the latter month higher on the scale of production. Increasing demand from contributing lines, including the implement, automotive, railway, steel making, machinery and heating equipment manufacturers promises a continuation of foundry activity through the late fall. A slight easing off in prices on pig iron is noted, while deliveries, except in the case of a few northern railways where coal shipments are heavy, are improved. The labor situation, particularly as applies to unskilled workmen is occasioning concern in the larger centers.

Iron Output Improves

The rapid recovery of pig iron production from the effects of the coal and railway strikes is of great interest to the foundry industry. According to statistics compiled by *Iron Trade Review*, September showed a gain of 206,113 tons over August. The production for last month was 2,016,778 gross tons, while August registered 1,810,665 tons. Further, the total of 188 furnaces in blast on the last day of September is the largest recorded since December, 1920 with the exception of June this year when 191 were active. Merchant pig iron produced in September totaled 349,087 tons giving a gain of 5565 tons over the previous month's figure of 343,522 tons. On a daily average basis, September showed 11,636 tons per day or an increase of 555 tons over the 11,081 ton total of merchant iron made in August. Eleven merchant stacks were blown in and 3 were blown out giving a gain of 8 for the past month. However, the most remarkable gain was shown in the total number of steel works stacks in blast. In the nonmerchant class, 42 stacks were blown in and a net gain of 37 is shown.

Prices of Raw Material for Foundry Use

CORRECTED TO OCT. 12

Iron		Scrap	
No. 2 Foundry, Valley	$32.00	Heavy melting steel, Valley	$21.75 to 22.00
No. 2 Southern, Birmingham	28.00 to 30.00	Heavy melting steel, Pitts	21.50 to 22.00
No. 2 Foundry, Chicago	32.00	Heavy melting steel, Chicago	18.50 to 19.00
No. 2 Foundry, Philadelphia	33.13 to 34.26	Stove plate, Chicago	19.75 to 20.25
No. 2 Foundry, Buffalo	31.00 to 32.00	No. 1 machy. cast, Chicago	24.00 to 24.50
Basic, Valley	30.50 to 31.00	No. 1 cast, Philadelphia	23.00 to 23.50
Basic, Buffalo	31.00 to 32.00	No. 1 cast, Birmingham	20.00 to 23.00
Malleable, Chicago	32.00	No. 1 cast, Buffalo	21.00 to 22.00
Malleable, Buffalo	31.00 to 32.00	Car wheels, iron, Pittsburgh	23.50 to 24.00
Coke		Car wheels, iron, Chicago	24.50 to 25.00
Connellsville foundry, coke	$12.00 to 13.00	Railroad malleable, Chicago	24.50 to 25.00
Wise county foundry, coke	13.00 to 13.50	Agricultural mal., Chicago	24.50 to 25.00
		Railroad malleable, Buffalo	20.50 to 21.50

Influence Is Marked

The influence of the increased activity in steel making and machinery manufacturing lines is strongly evident. The demand for rolls and ingot molds is in excess of foundry capacity and orders are on the books of shops making this class of equipment, extending through the remainder of the year. Railway car buying continues at a steady rate, while increasing purchases of machinery for railway repair and construction shops is bringing a demand for heavy machinery castings, which is unprecedented since the start of the depression. Locomotive buying continues to increase. According to the department of commerce, shipments of locomotives in August totaled 151, the largest since April, 1921, while the orders received mounted to 926, the highest figure given since October, 1920. Automobile manufacturers continue to furnish a strong market for castings. Although orders are not given far in advance, indications point to a steady demand through the winter with a possible increase after the first of the year. The National Automobile Chamber of Commerce, basing its estimate on shipments reported, states that the September production of automobiles amounted to a total of 205,950 cars of all classes. This records a seasonal decline, but the closed vehicle demand is strengthening the fall market.

Prospects Favorable

For the first time since 1920, the outlook for normal business in tractor and implement manufacturing lines is bright. Contracts for materials for use during 1923 indicate that implement companies are confident of a greater volume of sales than during the past two years. However, in this line, as in the automotive industries, purchases are being made conservatively. With last year's sales of implements estimated at 30 per cent of the normal requirements, following restricted buying due to manufacturing difficulties several years previously, the backed-up demand, it is thought, will furnish a strong market in 1923. The one disturbing factor is the decreased buying power of the farmer, due to low prices, coupled with the necessity of maintaining high prices on the part of the manufacturer, based on the high cost of raw materials and wage conditions in the industry. Building construction has fallen off but little with the advance of fall. Consequently the demand for castings from this source continues strong. Further, plumbing stocks in the hands of the dealers, builders hardware and domestic castings of all classes are not plentiful, and the requirements for stoves and furnaces continue large. Foundries, with few exceptions are not buying coke far in advance. Feeling prevails that production will increase, and that prices will be lower.

Nonferrous Prices

According to the *Daily Metal Trade* of Sept. 12, New York prices on nonferrous metals are as follows: Casting copper, 13.40c to 13.50c; electrolytic copper, 14.00c; Straits tin, 33.75c to 33.87½c; lead, 6.62½c to 6.75c; antimony, 6.75c to 7.00c; aluminum No. 12 alloy, producers' price, 21.00c to 21.20c and open market, 19.00c. Zinc is 6.62½c, E. St. Louis. The September monthly average prices for nonferrous metals follow:

(New York Quotations)

Casting Copper	Electro. Copper	Lead	Tin Straits	Antimony	Aluminum 98-99	Zinc St. Louis
13.45c	14.00	6.213	32.376	6.413	18.25c	7.40

Personal

C. P. Wolff has resigned his position as superintendent of the H. Mueller Mfg. Co., Milwaukee.

Joseph H. Shaw, formerly with the Shaw Bros. Foundry, Newark, N. J., has taken charge of the Phoenix Brass Foundry, Irvington, N. J.

C. J. McNamara, general manager of the Inland Malleable Iron & Steel Co., Terre Haute, Ind., has taken complete charge of sales for the organization.

Charles W. Wilson has resigned the positions of vice president and general manager of the Willys-Overland Co., Toledo, to become head of the Wilson Foundry & Machine Co., Pontiac, Mich., a subsidiary of the Willys-Overland Co.

Raymond K. Bowden, of Niles, O., has been appointed instructor in metallurgy, for 1922-23, at Carnegie Institute of Technology, Pittsburgh. Mr. Bowden is a graduate of Ohio State university, in the class of 1920.

Charles U. Smith has been appointed superintendent of the American Malleable Castings Co., plant at Marion, O. Mr. Smith formerly was factory superintendent of the Auto Specialty Co., St. Joseph, Mich.

M. F. King, formerly of the King Refractories Co., has joined the sales and service department of the Quigley Furnace Specialties Co., New York. Mr. King will devote his attention to service and sales work in New York city.

George Furman, late plant manager of the Chicago works of the Niagara Radiator & Boiler Co., and formerly associated with Henry E. Pridmore, Chicago, has become a member of the sales force of the Beardsley Piper Co., Chicago.

R. A. Spring, manager, and D. Campbell, foundry manager, Metters, Ltd., Sydney, Australia, are making an inspection tour in this country visiting stove foundries and enameling plants. C. E. Thomas, representative of the firm in London, England, met Messrs. Spring and Campbell in Vancouver and is accompanying them through this country.

J. F. Geary, recently superintendent for the Niagara Radiator Co., North Tonawanda, N. Y., and previously in charge of various plants of the United States Radiator Corp. and the American Radiator Co., is now district manager in Western New York, Ontario and North Western Pennsylvania for the Business Training Corp., New York, specializing in training courses in production methods for foremen and production executives.

H. B. Hanley, formerly metallurgical chemist and foundry superintendent for the New London Ship & Engine Co., Groton, Conn., is now employed by Whitehead Brothers Co., New York, Buffalo and Providence. Mr. Hanley will devote his entire time to investigations of foundry raw materials and consulting work.

The Phoenix Brass Foundry, Irvington, N. J., has completed a new plant at Cordier street and Chancellor avenue and now is equipped to make bronze, brass and aluminum castings. Joseph H. Shaw is superintendent.

With Apologies to Walt Mason

I have your little letter of October 3rd, referring to another that was written by a bird, who writes for information, and the query that he put, was "Whats the Price of Castins and shouldn't it be CUT?" In answer to his querry, I'll say he is sure lost, if he starts to cuttin' prices without figgering of his Costs. An if he knows his cost and has it figgered nice, and adds a little profit he will also know the price. At least he'll know for certain sure what HIS price ought to be for if he DON'T, he's goin to be a busted Foun-der-ie????? At the present cost of livin, cuttin prices listens good, but it calls for further reasonin than just because they should. Tell him you know conditions all the way from A to Z. No collections, no inquiries, business punk as it kin be. He'll find he'll gain New Customers for every one he's lost, if he has fixed his prices on the basis of his cost. If he can't make any profit at what other fellers figger, let him cut his Costs and then he'll find his little profits bigger, and if he then can't get the work when cut as much as able, just tell him to close up the shop and start a livry stable. For as certain sure as Holy Writ, he's headed straight for Toppet, if he tries to run a foun-der-rie without figgering on a profit, and in the race for Orders he'll be left at the Post, if he tries to fix a profit without knowing of his Cost. To guard agin temtation 'twould be well fer him to note, the graceful lines that follow, as was written by a POte:

COUNT THAT DAY LOST
WHOSE SLOW DESCENDIN SUN
SEES CASTINS SOLD AT COST
AND BIZNISS DUN FER FUN

A. J. Tuscany, *Secretary,*
Ohio State Foundrymen's Association.

Foundrymen's Association Is Formed

The Quad City Foundrymen's association was formed at the Manufacturers Hotel, Moline, Ill., Sept. 25. Invitations were sent to about 27 foundries, including gray-iron, malleable, brass steel and aluminum shops, and 75 foundrymen were in attendance at the first meeting. The following were elected officers: President, A. E. Hageboeck, Frank Foundries Corp., Moline; vice president, John Ploehn, French & Hecht Co., Davenport; secretary and treasurer, R. L. VanAlstyne, E. & T. Fairbanks & Co., East Moline. An executive committee consisting of the officers and four other members was decided upon. The following members were chosen: Harvey Soverhill, Davenport Locomotive Works, Davenport; P. J. Schmitz, Blake Specialty Co., Rock Island; L. E. Nutt, Moline Iron Works, Moline; J. L. Simmons, Union Malleable Iron Works, East Moline. John Ploehn, member of the sand committee of the American Foundrymen's association started a discussion on foundry sands. He reviewed what the American Foundrymen's association has done up to the present time and advised briefly about the progress of the work. The discussion following this report proved conclusively that the present method of buying sand is not satisfactory and everyone welcomed the specifications whereby sand could be bought and paid for on its merits. E. T. Runge of the E. T. Runge Cost Co., Cleveland, gave a fifty minute talk on foundry costs. This was followed by questions and a discussion for three-quarters of an hour, the gentlemen present showing great interest.

An expression of opinion was obtained from the members present and as a result the executive committee was instructed to prepare constitution and by-laws and map out a program for future work. The majority present favored monthly meetings, the fourth Monday in the month. It also seemed the opinion that the meetings should be held in Rock Island and Davenport alternately.

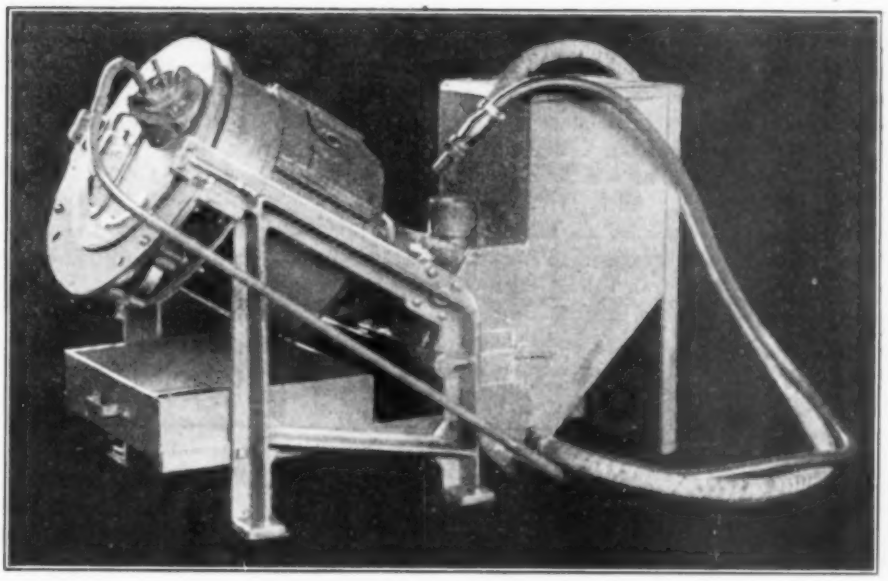
Obituary

Perry Hume Davis, for 30 years superintendent of the Moline Malleable Iron Co., St. Charles, Ill., died recently at his home in St. Charles. He was 66 years old. Mr. Davis was born in Moline, Ill., May 21, 1856. At the age of 14 years he started to work in a foundry, first as a coremaker and later serving his apprenticeship as a molder. Then he entered the employ of the Moline Malleable company as a journeyman molder and after two years went to the Union Malleable Iron Works at Moline as foundry foreman which position he held for 13 years, leaving to spend two years in the foundry of the Southern Pacific railroad at Sacramento, Cal. Returning to Moline at the request of the late W. B. Ullman, president of the Moline Malleable Iron Co., Mr. Davis became superintendent. When fire destroyed the plant at Moline in 1893, Mr. Davis took charge of the plant then erected at St. Charles. The St. Charles plant burned in 1915 and Mr. Davis laid out the present plant. Resigning from the company in June, 1920, Mr. Davis continued in an advisory capacity as a malleable castings specialist.

Herbert C. Follinger, manager of the Chicago office of the Chain Belt Co., died of pneumonia at his home in Chicago, Sept. 27. Mr. Follinger was 38 years of age at the time of his death, and was born at Fort Wayne, Ind. In 1902 he graduated from the Chicago Manual Training school, now part of the University of Chicago, and entered the employ of the Otis Elevator Co. He became associated with the Chain Belt Co., in 1914, and in 1916 was appointed district manager for the Chicago territory.

Sand Blast Mill Has Auxiliary Gun

To meet the requirements not only of the small shop in which one unit comprises the entire sandblast installation, but also in larger establishments, the W. W. Sly Manufacturing Co., Cleveland, has developed a combination type of sandblasting apparatus shown in the accompanying illustration. An additional feature was added to the regular tilting mill in the shape of an auxiliary sand hopper with a hand gun attachment. The hopper provides a reserve supply of abrasive and the hand gun always is ready for any odd or unusual sized casting that cannot be cleaned in the mill. With this equipment it is claimed that the operator can clean practically any casting. Other advantages claimed are that the air consumption is small, the abrasive is used over and over again. It is automatically returned to the gun and the dust is carried away by fan suction. The mill is shipped all set up with tight and close pulley drive. It requires a floor space 4 x 5 feet and when belted and connected to the compressed air line is ready to operate.



THE AUXILIARY GUN FURNISHES A READY MEANS OF SANDBLASTING CASTINGS THAT ARE TOO LARGE TO GO INTO THE BARREL

Gluepot Heat Controlled Automatically

When the proper temperature is established an automatic control shuts off the current and when the temperature drops a few degrees the heat is turned on again in a gluepot recently placed on the market by the J. D. Wallace Co., Chicago, and shown in the accompanying illustration. The control is established through a tube immediately above the heating element containing a sensitive, volatile substance which contracts and expands with the slightest change in temperature and provides a dependable action of ample power to actuate the control switch. The device may be operated from any lighting circuit and functions either as a water bath, hot air or dry heat pot. It is claimed that it never can overheat even if the current is left on all night. A cast aluminum glue container supported by special retainer lugs prevents the pot from floating, even when only partly filled. This method of suspension also minimizes the escape of moisture. The base cover forms a dead air insulator chamber between the heating unit and the bench and the air gap which surrounds the heating unit supplies further insulation between the heat unit and the base casting. Part of the bail extends across the center of the pot at the top and serves as a brush wiper, thus eliminating overflow and dripping around the edges.

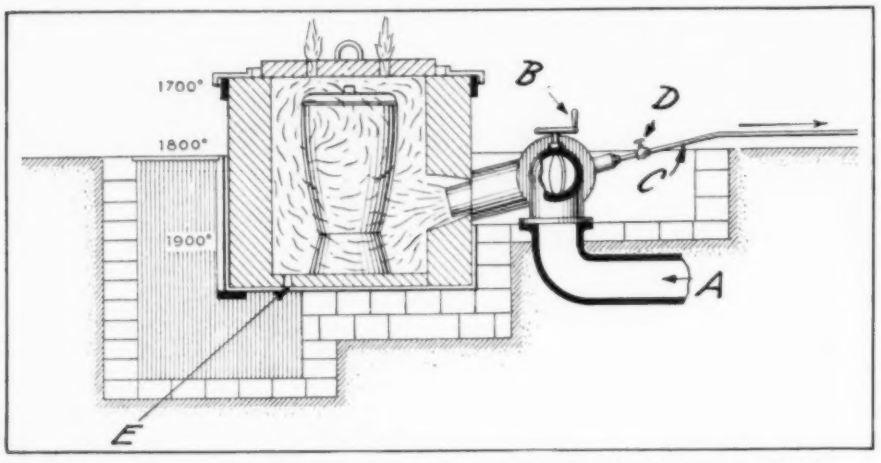
UNIFORM HEAT IS MAINTAINED AT ALL TIMES

The gluepot is adapted for heating any substance which requires a definite working temperature, such as glue, wax, pitch, tar, sealing compound or rosin. Among the principal advantages claimed for this device are it is automatic in action; glue is kept at proper temperature; no work lost on account of overcooked or under-heated glue; it may be used either as a water bath or a hot air or dry heat pot; it heats quickly, cannot cause fire and maintains heat at minimum cost.

Motors for Small Units

Small ball bearing motors manufactured by the Ohio Electric & Controller Co., Cleveland, are designed for use on laboratory appliances, bench machines such as sanders and jointers, drill presses and

other devices which may be attached to lighting systems. The motors are adequately protected by a cast iron cover yet the design is said to permit a large volume of air to circulate through it. Tests with an anemometer showed a movement at the rate of 6 cubic feet of air per minute at the inlet. If normal current is used as specified on the name plate, the motor is guaranteed to operate continuously at full rated load with a temperature rise of less than 40 degrees Cent. The starting switch works automatically cutting out the current from the starting winding when the rotor reaches a certain speed. The horsepower of these motors ranges from ⅛ to 1/3. The alternating current motors are made with a voltage of 110 to 440, 1, 2, or 3-phase and 25 to 60-cycle. Direct current motors have a voltage of from 32 to 250.



FRENCH CRUCIBLE FURNACE FOR MELTING NONFERROUS METALS

Small French Furnaces

By W. P. Mitchell

A new patented system of crucible furnaces designed by the Fours Rousseau, Paris, was recently shown at Paris Fair. These furnaces are used to melt nonferrous metals with heavy mineral oils. The accompanying illustration shows the arrangement of the furnace. Air is introduced through the pipe *A* and controlled by the valve *B*, while oil enters through the pipe *C* and is regulated by the valve *D*. A drain is provided at *E* to carry the metal to the pit in case the crucible breaks.

The most typical of these furnaces has a nominal capacity of 150 pounds and is capable of attaining temperatures varying from 600 to 1850 degrees Cent.

The crucible is heated by heavy petroleum oils, with a blower of about 2 horsepower, using 3650 revolutions per minute for the blast. Crucibles of the usual extra refractory quality are used, of a capacity varying from 10 to 150 pounds. It is claimed no chimney is required and no smoke is generated by the system of combustion employed.

The following figures are said to represent actual operating time:

Pounds	Metal	Melting Time Hrs.	Min.
130	Gray Iron		45
100	Steel	1	20
100	Nickel	1	..
130	Bronze		30
90	Wrought Iron	1	30

A point is made of the absence of sulphur in the average oil fuel, and the rapidity of melting. The furnaces are operated continuously for 8 hours after which the furnace is reopened to hasten cooling and to permit of inspection of the refractory lining for replacement should this be required.

Welding Society Meets

Problems of welding, as applied to steel and cast iron, especially regarding rail joints and railroad repair work, were considered at the fall meeting of the American Welding society in Chicago recently. Two days were devoted to the society's own sessions and two to joint sessions with the American Electric Railway Engineering association on the municipal pier.

Important among the papers were the report of the committee on specifications for steel to be welded and a joint report of the gas, electric and thermit welding research committees on general properties of cast iron in respect to weldability. Welding of cast iron by gas, thermit and electric arc processes were discussed.

In the joint sessions with the railway association problems relating to various types of rail joint welds and car repairs were considered. Need for research and standardization was emphasized by C. A. McCune, president American Welding society, supplemented by a description of the work of the American Bureau of Welding and Organized Research by William Spraragen, National Research council. Problems of welded rail joints were discussed by E. M. T. Ryder of the third avenue railway systems, New York.

An interesting development of welding of cast iron is found in the suggestion that it need not be confined to repair work but perfection of methods will render it possible to use this method in joining parts of various structures of cast iron as now is done in steel. This provides a wider field of endeavor than is possible at present.

However, according to the discussions at the meeting, the greatest field for welding of cast iron at present is in repair work where expense and time loss may be saved in the repair of broken machine parts. Study of the resulting welds and efforts to make them homogeneous and machinable is needed in the effort to bring this branch of the art to a point of greatest usefulness.

Particular attention was given to the application of welding of steel and cast iron in its application to the street railway problems, due to the joint meeting with the related association.

Sectional Meeting Held

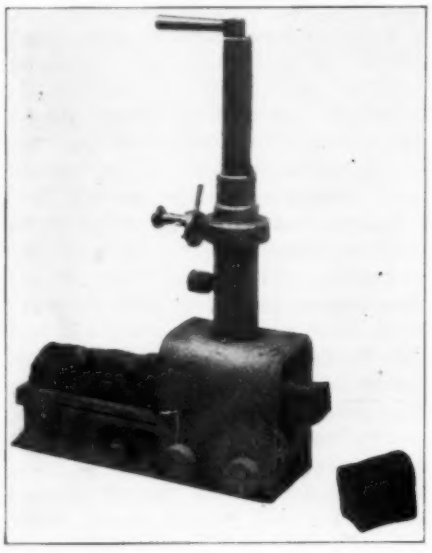
Metallic arc welding of cast iron was discussed by W. H. Namack at the meeting of the Northern New York section of the American Welding society, held at the engineering building, Union college, Schenectady, N. Y., Sept. 26. Mr. Namack is chairman of the committee on arc welding cast iron, which for the past year has been working on this problem.

English Pig and Scrap Breaker

In addition to the usual skull-cracker ball, heavy jaw crushers and hydraulic devices have been employed for many years for breaking pig iron and scrap into suitable sizes for cupola charges. Recently in England the Temple-Cox Research Co., Ltd., Bromely, Kent, has developed a device for breaking pig iron and scrap on the principle of gunfire. This machine was displayed for the first time at the recent foundry exhibition at Birmingham, by the United Brassfounders & Engineers, Ltd., Manchester, by whom it is being sold.

The machine consists of a short bedplate over which is mounted a carrier frame carrying a vertical cylinder or gun barrel. The plunger which actually breaks the pig or casting issues from the lower end of the gun barrel. The

bedplate acts as an anvil on which the piece to be broken is laid, and the carrier frame is so fitted as to permit the piece being broken to be moved freely backwards and forwards in a longitudinal direction so that the fracture may be made at any desired point.



BREAKER EMPLOYS EXPLOSIVE CHARGE TO GIVE POWER TO THE BLOW

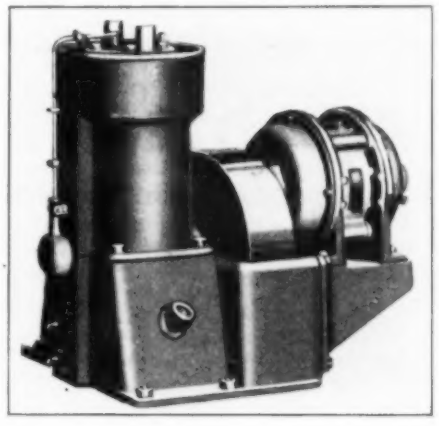
The striking hammer or plunger is about 1½ inches in diameter and weighs about 5 pounds. It is actuated by firing a rifle cartridge in a breech mechanism at the top of the barrel. Its movement is about 5 inches. The breech mechanism, which is of simple design, is constructed to receive ordinary rifle cartridges which are of course loaded only with powder and without bullets. The expansion of the powder gas is sufficient to drive the plunger into the piece to be broken with great force and the machine will break the hardest pig iron or casting of similar section, it is claimed, without difficulty.

Details of the apparatus as designed for breaking pig iron are shown in the accompanying illustration. As designed for breaking scrap, the anvil mechanism is somewhat altered and if necessary a heavier gun can be provided. It is said that one man can break pig iron with this machine at a cost of 20 cents per ton of pig iron. The breaker weighs about 250 pounds and since it develops its own power from the explosion of the cartridges, the device is readily portable.

Small Compressor Unit Self Contained

In addition to a plain belt drive design, the Ingersoll-Rand Co., 11 Broadway, New York, recently has placed on the market a new line of small vertical compressors, each size built as a self contained electric motor outfit, driven through pinion and internal gears as shown in the accompanying illustration. This latter type also may be adapted for a short belt drive. The compressing end and electric motor of both types are furnished mounted on a common sub-base and are not dependent on the foundation for correct alignment. Among the features to which attention is directed is the constant level lubrication system by which a constant level of oil is maintained thus insuring correct distribution. Other features include a constant speed unloader for plain belt drive machines; a centrifugal unloader for start and stop control machines; and the increased size of the water reservoir cooling pot.

The base forms an oil reservoir and pet cocks determine the maximum and minimum amount of oil. Oil is pumped from the reservoir to the constant level pan situated above the reservoir and directly under the connecting rod. An automatic device controls the unloading of the compressor by opening the inlet valve when the receiver pressure rises above a predetermined point. At a similar point below, the inlet valve is released and allows the pressure in the receiver to build up again. The centrifugal unloader allows the compressor to start under no load such as is essential when automatic stop and start control is employed and permits the motor to come to full speed before the load automatically is thrown on. The smallest unit is built with either ribbed cylinder for air cooling where the service is intermittent, or, a water jacketed cylinder of the reservoir type for constant service. All other sizes are provided with water jackets.



ELECTRICALLY GEAR DRIVEN AIR COMPRESSORS SHOWING THE 3 X 3-INCH AIR COOLED AND THE 4½ X 5-INCH WATER COOLED SIZES

Organize New Company

The Iron Trade Products Co. with offices in Pittsburgh, Philadelphia and New York, supplying raw materials to the steel trade, has organized under Delaware charter, the Big Four Fluorspar & Ore Co. The latter company has absorbed some well-known fluorspar properties in Crittendon county, Ky., including the following: Big Four mine, the Love mine, Deer Creek mine and Crittendon Springs mine.

The general offices of the new company are in the Farmers Bank building, Pittsburgh, in the offices of the Iron Trade Products Co. The officers are W. J. Strassburger, president; J. L. Hukill, vice president; Louis J. Adler, treasurer; and Huntington Downer, secretary.

Bellows for Dusting Blacking in Molds

A bellows adapted for blowing parting powder, plumbago, or blacking into molds has been designed by William Allday & Co., Paradise Street, Birmingham, England. It consists of an ordinary foundry bellows provided with a special valve so that when the parting powder is inserted through a hole in the top of the bellows it is properly blown out through the nozzle. The hole through which the parting powder is introduced is plugged by a metal-top cork. By means of this apparatus it is said that the parting powder can readily be sprayed into crevices and nooks which it might otherwise be difficult to reach.

Discontinue Production of Tractors

Decision of the General Motors Corp., Detroit, to discontinue the manufacture of tractors and farm implements, means liquidation of the Samson Tractor Co., Janesville, Wis. The Samson plant is to be turned over to the Chevrolet Motors division, beginning at once and progressing as the tractor and implement business is wound up. It is reported part of the Janesville plant will be used for the production of an air-cooled motor vehicle which General Motors Corp. is said to be developing. More than $5,000,000 has been spent in erecting the Janesville plant, which has one of the largest foundries in the West.

Plan Fall Meeting

The fall meeting of the National Founders' association will be held Nov. 22 and 23 at the Hotel Astor, New York City. The program will contain the names of speakers of national importance.

Equipment Inquiry Increases

Marked Improvement in Demand for Foundry Equipment and Supplies Is Noted—Molding Machine Demand Is Large—Cleaning Room Equipment Active

ALTHOUGH the volume of sales reported by foundry equipment manufacturers is not yet commensurate with the state of foundry operations, improvement continues in practically all sections of the country. Molding machines, in particular, are in demand due to the growing labor shortage and the equipping of shops to meet increasing demand. The Stoney Foundry Enginering & Equipment Co., Cleveland, in addition to other sales recently placed shakeout bales with the American Radiator Co. for its Buffalo plant. The latter interest also has purchased two complete sand mixing systems from the Standard Sand & Machine Co., Cleveland. The Deming Co., Salem, O. has purchased a 54-inch cupola from the Whiting Corp., Harvey, Ill., the order being placed through the Austin Co., Cleveland. Hillis & Co., Halifax, N. S. and the General Fire Extinguisher Co., Providence, are among the recent purchasers of cranes from the Northern Engineering Works, Detroit. The Ford Motor Co., Detroit, is reported to be considering the purchase of additional molding machine equipment. An active demand for cleaning room and dust arresting equipment is reported. Recent sales by the W. W. Sly Mfg. Co., Cleveland, in the Central States include 19 square and round tumbling mills with a dust arrester to the Ferro Machine & Foundry Co., Cleveland; a tumbling mill and dust arrester installation to the Erie City Iron Works, Erie, Pa.; tumbling mills to Chisholm & Moore Mfg. Co., Cleveland, Trumbull Mfg. Co., Warren, O., the Union Radiator Co., Johnstown, Pa.; a complete sandblast room installation to the Westinghouse Electric & Mfg. Co., Trafford City, Pa.; and dust arresters to the Superior Gas Engine Co., Springfield, O. and the Continental Heater Co., Dunkirk, N. Y. In addition the W. W. Sly company recently has sold sandblast equipment for export to India and a dust arrester installation for South Africa.

Marked Advance in Pittsburgh Inquiry

SUDDEN improvement is noted in the foundry equipment market in the Pittsburgh territory. Inquiries are enveloping sellers and in connection with molding machines particularly, are on a large scale, more inquiries having been received by the Herman Pneumatic Machine Co. during the past 10 days than in any like period in its history for that line of equipment. Some of these already have turned into orders, indicative of need for their early use on the part of the foundries, and additional sizable orders for molding machines as well as other equipment are scheduled to be closed within the next week or 10 days. Recent buyers of molding machines include the Kelsey Wheel Co., Detroit; Chapman Valve Mfg. Co., Indian Orchard, Mass.; the Pittsburgh Steel Foundry Co., Glassport, Pa., one each; and the Massillon Steel Castings Co., Massillon, O., two machines. An eastern railroad equipment interest has placed a verbal order for $50,000 to $60,000 worth of molding machine equipment and more is to be bought. Work is proceeding upon the 8 or 10 machines involved. Foundry operators apparently realize that the prices on equipment are on the upward trend and in connection with molding machines, for which the raw material now has to be bought, prices at least 10 per cent higher have to be named. Several other sellers report similar conditions in other lines, two or three cupola orders having recently been placed and at least three core oven propositions being up for attention. One of these latter is the Centre Foundry & Machine Co., Warwood, W. Va., and may not be closed until next spring. The second also is for a Wheeling, W. Va., district user but will be closed promptly. Another is a local buyer who has been looking for a second-hand core oven, but failure to locate suitable equipment may bring about the sale of a new outfit. One recent order involved a 49-inch cupola from a Scottdale, Pa., user; a second called for one each 49-inch and 46-inch cupola, while a third specified a cupola together with an elevator from a Greensburg territory foundry which was placed with the Whiting Corp. Recent ladle orders include two 800 and 3000-pound capacity, respectively. The Centre Foundry & Machine Co. referred to above, recently placed an additional order with the Northern Engineering Works, Detroit, calling for a 2-motor, 10-ton trolley. A Roanoke, Va., foundry purchased approximately $700 worth of steel flasks and other foundries not so far distant have placed smaller flask orders, together with various orders for riddles, airbrakes, crucibles, and other small supplies. One plant in the Philadelphia district is inquiring for a complete foundry equipment installation and one or two Pittsburgh dealers are figuring upon it. Two foundries in the immediate Pittsburgh vicinity likewise are inquiring for complete layouts. Both of these have made partial purchases and additional orders will be filed at an early date. The Titusville Iron Works, Titusville, Pa., is said to be in the market again for equipment for its new addition. The crane and hoist demand from foundries has been improving slightly and a 5-ton crane for the Pittsburgh Valve Foundry & Construction Co., Pittsburgh, is understood to have been awarded the Champion Engineering Co., Kenton, O., last week while the Penn Mold & Mfg. Co. awarded the Aliance Machine Co., a 20-ton 4-motor crane several days ago. A recent hoist purchaser located in the Pittsburgh district took three from the Northern Engineering Works, Detroit, and the C. & G. Cooper Co., Mt. Vernon, O., bought six 2-ton hoists from the Shepard Electric Crane & Hoist Co. This latter interest likewise was awarded a contract for one 2-ton hoist by the Morrow Mfg. Co., Wellston, O. A few inquiries are current from foundry operators for grinders and other machine tools suitable for foundry use.

Demand Grows in Eastern Territory

WHILE in receipt of few large orders, dealers in foundry equipment report an increasing volume of miscellaneous demand. At the same time some projects are under way which in all likelihood will develop into substantial orders in the near future. The outstanding demand at the moment appears to be for molding machines, sand cutters and flasks. Prices generally are unchanged, although an advance in some lines is being expected at any time. Molding machines are among items

likely to undergo an advance soon, at least two sellers now considering such a revision. Recent buyers of foundry equipment include the Consolidated Machine Tool Corp. of America, New York city, which has just closed on three 5-ton electric cranes to the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. The Consolidated corporation is to build a new foundry at its Hillis & Jones plant, Wilmington, Del. The National Foundry Co., Brooklyn, has closed on a 1000-foot conveyor system to the Tramrail division of the Cleveland Crane & Engineering Co., Wickliffe, O. Another buyer is the American Car & Foundry Co., which has closed on a cupola for its Madison, Ill., plant to the Whiting Corp., Harvey, Ill., and an 18-ton locomotive crane 50-foot boom, for its St. Charles, Mo., plant, to the Orton & Steinbrenner Co., Chicago. The Nairn Linoleum Co., Kearny, N. J., has bought four 72-inch turntables from the Whiting Corp. Among new foundry projects are a 100 x 150-foot building for the Eastern Foundry Co., Boyertown, Pa., manufacturer of pipe; a 100 x 100-foot foundry addition for the Colvin Foundry Co., Providence, R. I., a new foundry for the Pullman Co., Chicago, and also one for the Monroe Auto Equipment Co., Monroe, Mich. The General Electric Co. recently installed a sandb'ast room, built by the W. W. Sly Mfg. Co., Cleveland, at its Pittsfield, Mass., plant.

Advance Noted in Chicago District

CONSIDERABLE more activity is evident in foundry equipment than during recent months. This ranges from inquiries for ladles and small supplies to cupolas, cranes, tumbling barrels and other heavy equipment. It is apparent that many foundries are adding to their facilities or are replacing obsolete devices. That the melt is increasing is indicated by the purchase of a 54-inch cupola by the Austin Co., Cleveland; a cupola by Cornell University, Ithaca, N. Y.; a special 78-inch cupola, by the American Car & Foundry Co., which has closed on a cupola by the American Radiator Co., Buffalo; a 42-inch cupola by the National Engineering Co., Irwin, Pa., and a 32-inch cupola by the B. C. Equipment Co., Vancouver, British Columbia, all sold by the Whiting Corp., Harvey, Ill. This builder also has booked tumbling barrels as follows: Birmingham Machine & Foundry Co., Birmingham, Ala., two 42 x 72 inch tumblers; J. W. Pohlman Foundry Co., Buffalo, one 24 x 48-inch and one 30 x 38-inch tumbler; Hudson Motor Co., Detroit, two 36 x 48-inch tumblers; Atlantic Steel Castings Co., Chester, Pa., a 42 x 60-inch tumbler; International Harvester Co., Chicago, two 36 x 60-inch tumblers. The Pullman Co. has ordered a 30,000 pound reservoir ladle from the Whiting Corp. The National Engineering Co. has sold three sand mixers to users in Wisconsin during the past week. Engineers interested in foundry building and design, find much increased activity in this department and are busy with a number of new projects, as well as additions and alterations. As increased business comes to foundries, they are equipping to handle their work more efficiently and this is reflected in demand for modern equipment. The Chicago Hardware Foundry Co. recently has purchased a dust arrester from the W. W. Sly Mfg. Co., Cleveland. Other sales of the latter interest in this district include tumbling mills for the Oliver Chilled Plow Works, South Bend, Ind., the Hubbard Steel Foundry, East Chicago, Ind., the Piston Foundries, Inc., Minneapolis and the Warner Corp., Muncie, Ind.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

The plant of the Star Foundry, Oshkosh, Wis., recently was damaged by fire. The plant will be rebuilt it is understood.

Erection of a brass foundry is planned by the Eager Electric Co., Watertown, N. Y.

Contract for the erection of a 1-story plant addition has been let by the Meeker's Union Foundry Corp., Norwalk, Conn.

The Springfield Bronze Co., Springfield, Mass., has let the contract for the erection of an addition to its foundry, 30 x 40 feet.

Capitalized at $10,000 the Aman Foundry Co., Detroit, recently was incorporated by John Aman and others.

Erection of an addition to its plant is being planned by the Buffalo Bronze Die-Casting Co., 90 Arthur street, Buffalo.

The Lockport Foundries Corp., Lockport, N. Y., is reported planning the erection of a plant building.

The plant of the North Milwaukee Foundry Co., North Milwaukee, Wis., recently was damaged by fire.

The Advance Foundry Co., Dayton, O., plans the erection of an addition to its plant, 100 x 500 feet.

The Keith Furnace Co., Des Moines, Iowa, is completing the erection of a foundry building.

The gray iron foundry being erected by the B. C. Chatfield Foundry Co., Gladstone, Wis., is nearing completion.

Erection of a warehouse building, 35 x 146 feet, is planned by the Advance Pattern & Foundry Co., 2734 West Thirty-sixth place, Chicago.

The American Building Foundry Co., 2300 South Springfield avenue, Chicago, has let the contract for the erection of a plant addition to be 35 x 93 feet.

The Federal Pattern Co., 8741 Kercheval avenue, Detroit, has been incorporated with a capital stock of $5000 by B. M. Uhlig, E. F. Wunsch and J. Louis Horn.

The Sunnyside Foundry, Brooklyn, N. Y., recently organized, plans to establish a plant in Long Island City, in a 1-story building, 25 x 60 feet.

Work will be started shortly on the erection of a 1 and 2-story foundry building, 100 x 150 feet, for the Eastern Foundry Co., Boyerstown, Pa. A. S. Kepner is architect.

Work has been completed on the erection of an addition to the plant of the C. L. Dorer Foundry, Bellaire, O. A traveling crane has been installed.

The Die Sinking & Rubber Mold Co., Akron, O., has been incorporated with a capital stock of $10,000 by William H. Barkwill, M. R. Barkwill, S. W. Sweet, W. A. Heftlman and Henry Kish.

[illegible] Hester Co., Lafayette street, Utica, N. Y., has awarded a contract for the erection of a 1-story plant building, 72 x 100 feet. H. R. Beebee, Utica City National Bank building, was awarded the contract.

Contract has been awarded by the Washington Iron Works, Seattle, to the Austin Co., Smith building, Seattle, for the erection of a 1-story foundry building to have a floor space of 65,000 square feet.

The Mid-West Castings Co., Middletown, O., will open its plant near here Oct. 16, according to an announcement by Harry S. Wise, secretary and treasurer of the company. It has been closed for some time.

The Louis Huetwohl Brass Foundry, Brooklyn, N. Y., recently was incorporated with a capital stock of $50,000 by C. Huetwohl, G. and L. Schimper. The company is represented by I. Phillips, 303 West 122nd street, Brooklyn.

The Mid-City Foundry Corp., 1901 South Rockwell street, Chicago, has been incorporated with a capital stock of $15,000 by Julius Drofka, Carl J. Berg, Frank Cederwall and L. Dahlberg. The company is represented by J. Henry Debus, 19 South La Salle street, Chicago.

Stockholders of the American Machine & Foundry Co., 511 Fifth avenue, New York, are considering increasing the company's capital stock from $2,000,000 to $10,00,000. It is understood a portion of the proposed increase will be devoted to improvements.

Contract has been awarded the C. I. Bigney Construction Co., 357 Westminster street, Provi-

dence, R. I., for the erection of a 1-story addition to the plant of the Colvin Foundry Co., Globe street, Providence, R. I., to be 100 x 100 feet.

The Canada Electric Castings Co., Ltd., Orillia, Ont., is completing the erection of a new plant, 50 x 350 feet. Part of the building will be devoted to brass casting. J. B. Tudhope is president and A. H. R. Burrows vice president and general manager of the company.

The Albany Steel & Brass Corp., 716 West Madison street, Chicago, recently was incorporated with 100 shares without par value by J. Kendall, G. Mitchell and Herbert Green. The company is represented by J. K. Mitchell, 1208 American Bond & Mortgage building, Chicago.

The Consolidated Machine Tool Corp., 17 East Forty-second street, New York, plans a bond issue to provide for plant improvements, including the erection of a 2-story foundry at the Hilles & Jones Co. division plant, Wilmington, Del. C. K. Lassiter is president of the corporation.

The McWane Cast Iron Pipe Co., Birmingham, Ala., has awarded the contract for the erection of its proposed pipe foundry at East Birmingham to the Ingalls Iron Works, Birmingham. The first unit of the plant will be one story, 105 x 340 feet. J. R. McWane is president of the company.

The General Die Casting & Machine Co., 2533 North Ashland avenue, Chicago, recently was incorporated with a capital stock of $25,000 to manufacture and deal in dies, die castings, etc., by Ebon C. Tourle, William F. Waugh, Walter F. Olds, Will A. Kelly and M. M. Soenterath. The company is represented by Olds & Tourje, Marquette building, Chicago. The plans of the company have not been announced.

The Detroit Foundry Co. has leased the foundry of the American Blower Co., which discontinued the operation of its Detroit foundry a year ago after purchasing the former plant of the Lane & Bodley Co., Cincinnati. The foundry will provide the Detroit Foundry Co. with about twice the floor space of its present plant at East Grand boulevard.

The Acme Brass & Metal Works, Waupaca, Wis., has been organized with a capital stock of $75,000 to manufacture brass and metal castings and products. Incorporators of the company are B. C. Koepke, Louis Larson and J. M. Braum. It is understood that an existing brass foundry and machine shop will be taken over.

Capitalized at $5000 the Cragin Pattern & Castings Co., 4916-28 Bloomingdale avenue, Chicago, recently was incorporated to manufacture and deal in wood and metal patterns and castings, by George W. Swain, Harold D. Burgess and Elbridge B. Pierce. The company is represented by Scott, Bancroft, Martin & MacLiesh, 134 South La Salle street, Chicago. Plans of the company have not been made public.

Remodeling of its foundry into a machine shop and the erection of a 1-story extension is planned by the Rockwood Mfg. Co., Indianapolis. Contract for the work has been let and construction is expected to be started shortly. The remodeled building will be of brick and heavy mill construction with wood block floors, steel sash and a gravel roof. It will be equipped with a traveling crane.

Decision of the General Motors Corp., Detroit, to discontinue the manufacture of tractors and farm implements, means liquidation of the Samson Tractor Co., Janesville, Wis. The Samson plant is to be turned over to the Chevrolet Motors division of the corporation. It is understood part of the Janesville plant will be used for the production of air-cooled engines. More than $5,000,000 has been spent in erecting the Janesville plant which has one of the largest foundries in the Middle West.

Equipped for making castings in bronze, brass or aluminum in any size or quantity, the Phoenix Brass Foundry, Irvington, N. J., recently completed its new foundry building. The company maintains a large shop for machining, finishing and assembling as well as a pattern shop for either wood or metal patterns. With office and works at 857-961 Springfield avenue and foundry at Cordier street and Chancellor avenue, the company now is prepared to do floor, bench or machine molding from architectural bronze to production work.

New Trade Publications

TUMBLING MILLS—A 32-page illustrated booklet has been published by the Whiting Corp., Harvey, Ill., in which tumbling mills of various sizes and types are described and illustrated. Each size and type is described in detail.

TRUCKS AND TURNTABLES—Trucks, charging cars, turntables, dump buckets, dump cars, core oven cars and trucks, etc., are described and illustrated in a 16-page illustrated booklet recently published by the Whiting Corp., Harvey, Ill.

CRANES—The Northern Engineering Works, Detroit, is circulating a 4-page illustrated folder in which various types of its cranes and hoists are described and illustrated. These include jib cranes, pillar cranes, and truck and stacking cranes. Each type described is illustrated.

BEARING METALS—A. W. Cadman Mfg. Co., Pittsburgh, has published a 16-page illustrated booklet in which bearing metals are described. The booklet contains some very interesting information including requirements of bearing metals, properties, tensile strength and bonding properties, etc.

LADLES—The Whiting Corp., Harvey, Ill., has published a 32-page illustrated booklet in which ladles of several types are described and illustrated. These include crane ladles, truck ladles, bottom-tap ladles, trolley and shank ladles, car wheel and reservoir ladles, etc. Each type is described and illustrated.

CORE OVEN EQUIPMENT—A 24-page illustrated booklet has been published by the Whiting Corp., Harvey, Ill., in which core oven equipment is described and illustrated. In addition to the ovens, the equipment described includes cars and trucks, puller machines, benches, racks, etc.

TURBO-BLOWERS AND TURBINES—The Power Turbo-Blower Co., New York, has published a 32-page illustrated booklet in which turbo-blowers and turbines are described and illustrated. The equipment is described in detail as to operation, construction, etc. The latter end of the booklet contains a number of illustrations showing installations.

CRANES AND HOISTS—The Northern Engineering Works, Detroit, is circulating a small 16-page illustrated booklet in which various installations of its cranes and hoists are shown. These include electric cranes, electric hoists, air hoists, air jacks, hand-power cranes, jib and pillar cranes, monorail trolleys, grab-bucket cranes, stacking cranes, gantries, etc.

DIE CASTINGS—The Superior Die Casting Co., Cleveland, has published a 12-page illustrated booklet in which die castings are described and illustrated. Some interesting and valuable information is given in the booklet, and the illustrations show the numerous items which are successfully die cast by the company's process. According to the booklet, some of the castings illustrated, heretofore were considered beyond the range of die castings.

ELECTRIC HOISTS—A 4-page illustrated bulletin has been published by the Sprague Electric Works of the General Electric Co., Schenectady, N. Y., in which electric hoists with worm drive are described and illustrated. Some of the features claimed include totally enclosed gears, automatic lubrication, roller bearing motor, accessibility, worm drive, electric motor brake, drum-type control and automatic stop. Capacities of these hoists range from ¼ to 1 ton. They have a speed of 25 feet per minute and a lift of 20 feet. Either direct or alternating current may be used.

DUST COLLECTOR—The Northern Blower Co., Cleveland, has issued an illustrated leaflet describing the use and construction of its dry process dust collector. The machine is made up of a reinforced steel frame with seams well sealed so as to make it air tight and weather proof. The dust laden air enters the case depositing a large part of the dust in the steel hopper, the remaining particles are collected on a series of fabric screens which, as they become overloaded, drop the collected dust to the hopper below. From two to four times daily the screens are thoroughly emptied by a rapping system which is so constructed as to give each one an equal vibration.

PULVERIZED COAL SYSTEMS—Design, installation and operation of pulverized coal systems are outlined in a 28-page illustrated booklet recently published by the Raymond Bros. Engineering Co., Chicago. The booklet goes into detail and gives some interesting facts and figures concerning the pulverized coal system. A partial list of applications on furnaces to which the system may be put includes malleable iron melting, puddling furnaces, billet and bar heating, slab and plate heating, forge and welding furnaces, core ovens, preheating furnaces, ingot reheating, busheling, continuous heating, ore sintering furnaces, ore melting and reducing, annealing ovens, industrial boilers, etc.

OVENS—An 8-page illustrated booklet has been published by the General Electric Co., Schenectady, N. Y., in which electrically heated ovens are described and illustrated. Some of the many operations which have been adapted to electric heating with automatic temperature control include annealing copper, brass, carbon and nickel steels; annealing glass vacuum bottles; baking japan on wood and metals; baking enamel on magnet wire; baking lithograph work; baking foundry cores; baking grinding wheels; baking cement in plate type rheostats; baking insulation on resistor tubes; baking furnace lining; baking commutators; drying acid washed metals, etc. The oven is described in detail and some interesting information is given.

LIQUID FUEL BURNING—F. J. Ryan & Co., Philadelphia, have published an 8-page illustrated folder in which liquid fuel burning for the generation of steam is discussed, and liquid fuel burning equipment described and illustrated. The equipment described includes steam atomization burners, air jet burners, steam mechanical burners and a type of burner manufactured by the company. In operation of this latter burner, the oil passes finally through currents of air coming both from the outside cone and through the center. The mixing effect caused by the flow and expansion of the air results in a combined mixture which passes out of the burner in a whirling spray ready for combustion. Other details of construction and operation are given.